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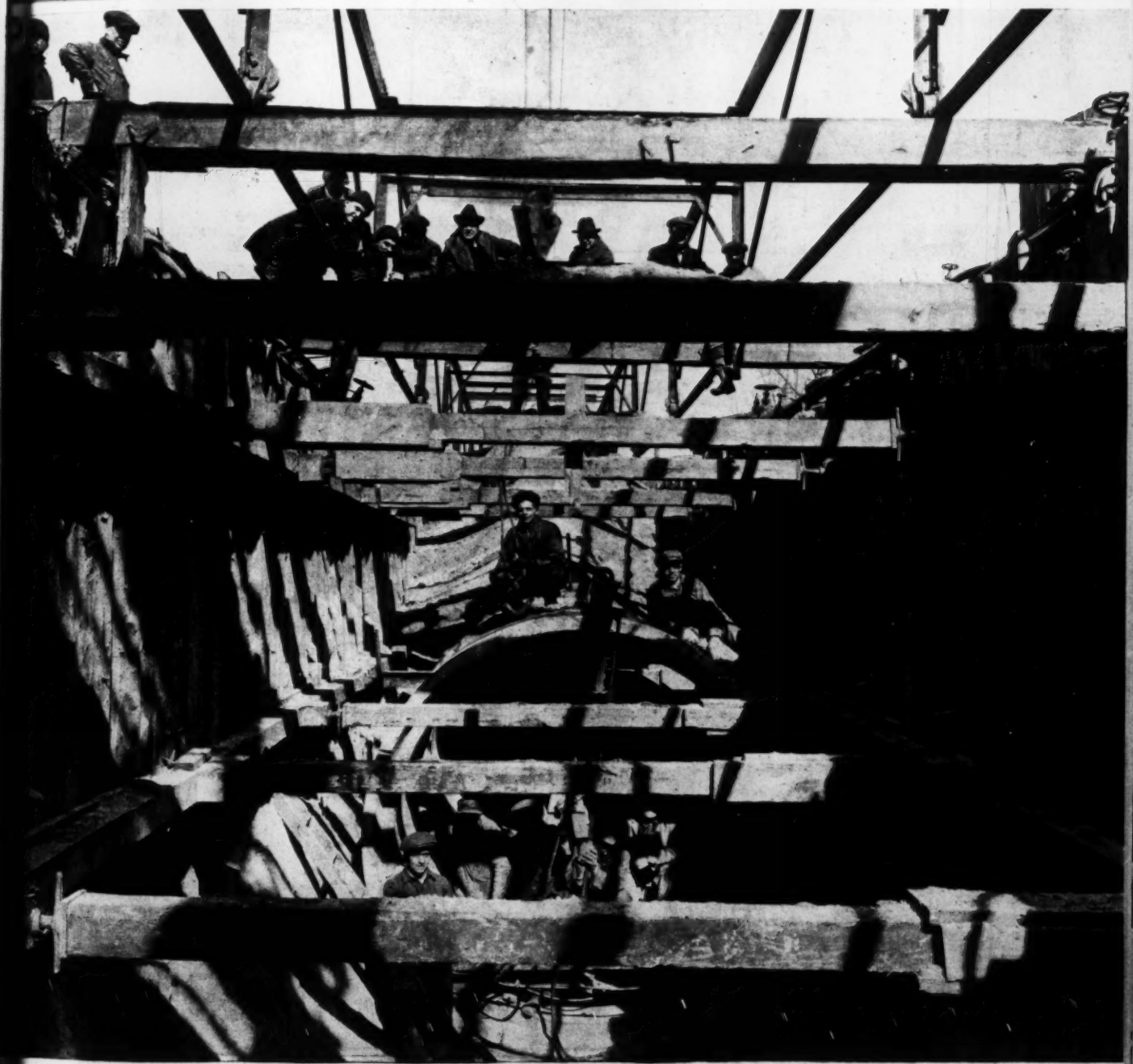
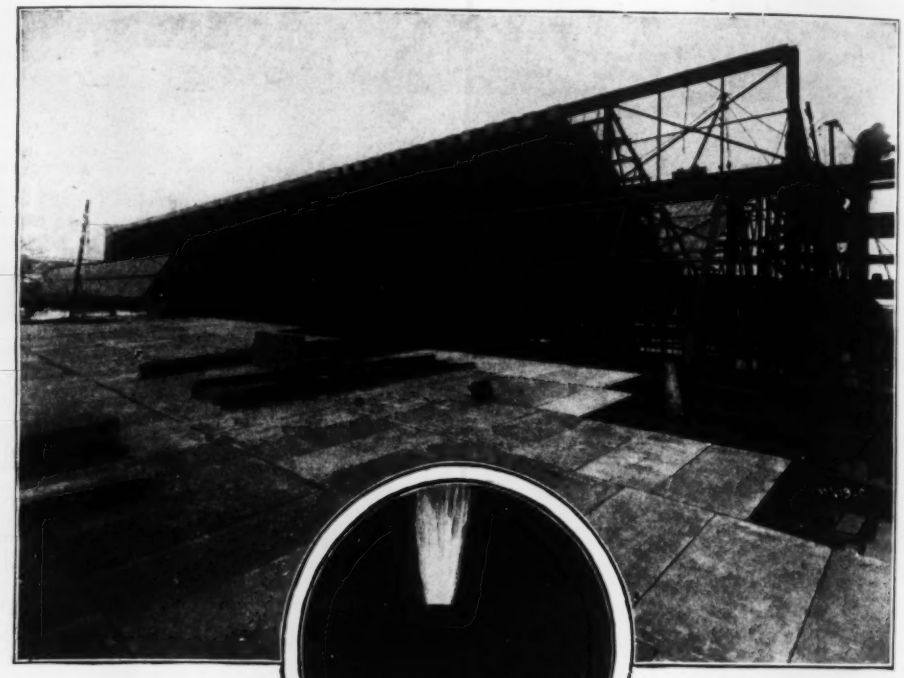


Building Intercepting Sewer in Hammond, Ind.

Discussion on Behavior of Concrete

Flood Protection Plan—Pueblo District

Six Pages of "Job and Office" Articles



The new Pullman Company foundry, Chicago, Ill., covered with Federal Tile. Frank D. Chase, Inc., Engineers.

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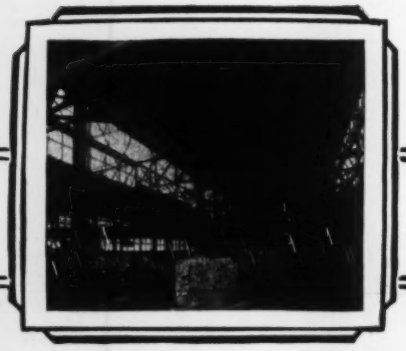

Interior view of Pullman foundry

"The Roof for Permanence"

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Public Opinion Wins

JUDGE GARY and his associates in the steel business have had their ears to the ground since their inept report of last month in which they questioned the early possibility of abolishing the 12-hr. day. The head of the Steel Corporation now finds that he is "decidedly opposed to the 12-hr. day" and that, "practically all the manufacturers of iron and steel in this country have positively agreed to the entire abolition of the 12-hr. day as soon as there is sufficient labor to permit it." This is a return to that appreciation of public sentiment that has generally characterized the Steel Corporation. Unquestionably, there are tremendous labor difficulties involved in the turn to the shorter shift, but they are far from insurmountable. In view of the interest the public is taking in this issue there is every reason to believe that the President will see that effort is made to bring about the reform at the earliest possible date.

Who Restricts Apprentices?

RESTRICTION of apprentices has been a common complaint against labor unions. The condemnation is a general one. We are told that one of the reasons for the shortage of building mechanics is that the unions restrict entrance into the trades. Whatever may be the truth in specific instances and places the facts at New York at least do not warrant the charge. There it is the contractors and not the unions who restrict apprentices. For example, in the carpenter trade union rules would permit of the employment on New York operations of 2,600 apprentices. As a matter of fact, there are only 800 in the city. The painters' and decorators' unions would allow 800, but only 125 apprentices are to be found. In general, there are at work only 40 to 50 per cent of the apprentices allowed by union rules. The only exceptions are in the bricklaying and the electrical trades where the quotas are nearly full. Where the number of apprentices is below quota the reason invariably is that the contractors are unwilling to go to the trouble of training the boys. Of course, union rules do place limitations on apprentices, but until the time comes when the contractors have employed all the apprentices that the unions allow, contractors have no reason to complain against union restrictions and the public's charge against the building industry should lie at the door of the contractors and not at that of the unions.

Building Height Uncertainties

LIMITATION of city building heights by law seems to be in an epidemic stage at the moment. Half a dozen cities have concerned themselves with the question in recent months. Their conditions are quite different, and the apparent motives of the height limitation movement are just as various. In one or two cities the protection of a particular building or street appears to be at issue, while in others the objective is more general. In still other cases no immediate motive is apparent. Except in one case, it is proposed to restrict the height of future building to a lower point than the owner's or architect's choice would fix. The exception is Boston, where existing height limits on a particular street are to be raised in order to permit better utilization of the land. Nowhere, however, has substantial reasoning been brought to bear on the problem. So far as can be judged, esthetic notions are leading factors in the discussion—a belief that high buildings are unsightly in themselves or are harmful to neighbors, or the vague notion that civic beauty lies in a uniform sky line. Such beliefs do not appeal very strongly to the general run of men, and the successful development of tall buildings in both isolated and row arrangements, and the strong demand for space in them, are practical answers to many of the claims made by those who advocate restriction. Transportation difficulties, or other real objections arising out of the intense concentration of population which high buildings produce, have almost never been made an argument in height limitation, nor have they been studied with due care to determine their bearing on the problem. In cities of large size and great concentration of business these difficulties and objections are serious—though just how serious is somewhat uncertain—while in smaller cities they are substantially non-existent. In the meantime the esthetic discussion of high buildings remains largely a matter of diverging personal views, and the skyscraper has rapidly become a feature of even the smaller country metropolis, where for many decades to come such matters as zoning and setbacks can have no meaning. Until a full and convincing study of the relation of the skyscraper to community life and to the rights of different parties has been made, it is not likely that the height restriction movement will progress beyond the condition of breaking out in an occasional epidemic, as at present.

For a New Niagara Treaty

EVENTS are shaping themselves for an early revision of the treaty provisions for the use of the water power on the Niagara and St. Lawrence Rivers. On this side of the boundary the new tunnel and power house of the Niagara Falls Power Co. is nearing completion, while in Ontario the Queenston power house has nearly its full installation in wheels. This means that there are available power units in capacity far in excess of the flowage permitted under the existing treaty and water is running to waste over the Falls, water that is in no way necessary to the scenic grandeur of that spectacle. Moreover, the recent election in Ontario brings back into power the supporters of government owned and operated power, notably Sir Adam Beck, the father of the Ontario "Hydro." This new administration is committed to the utmost development of all the border water flowing by the province. Both

political and industrial demands make imperative that some international agreement be reached whereby Canada gets more than the 36,000 sec.ft. and the United States more than the 20,000 sec.ft. now permitted. The two governments are in possession of all the necessary hydraulic data and the discussion now is in the realms of diplomacy, with the customary jockeying inherent in diplomatic discussion, but it can hardly be doubted that the pressure from both sides of the boundary for some settlement will soon bring about at least a temporary agreement from which later a new treaty will evolve.

The Penalty of Neglect

THE present water shortage in portions of northeastern New Jersey affords an example of the penalty of neglect. There is most cause of alarm in the Elizabeth-Plainfield section where it has been known for years that twenty communities served by five water companies might face a serious water shortage any day. The communities and the companies have agitated the question from time to time but with no fruitful result. The State Conservation and Development Commission obtained from Allen Hazen a comprehensive report showing that water in plenty for decades to come could be had for northeastern New Jersey by carrying out any one of several water storage possibilities (see *Engineering News-Record*, March 16, 1922, p. 430). A commission to provide a joint supply for wholesale distribution and for co-ordinating the various municipal and private water purveyors in northeastern New Jersey was proposed by Mr. Hazen. The municipalities, the water companies, and the public at large in northeastern New Jersey seem to have been indifferent to the Hazen report. The major difficulty in this New Jersey region lies in the fact that while various private water companies are trying, naturally enough, to conserve their own interests in the most readily available sources of supply, and have largely consolidated their interests, the municipalities have never worked in unison to meet their water needs. If the cities and towns could unite under able leadership, as was suggested in the Hazen report, the water companies would doubtless fall quickly into line and all northeastern New Jersey might soon be insured of a plentiful, reasonably cheap and pure water supply for a century to come.

Service Charge Unpopular

ALTHOUGH based on sound reasoning designed to distribute equitably the cost of water, gas and electric current, the service charge is unpopular. This is reflected by statute or utility commission prohibitions in some states. A statute enacted this year by the New York legislature is directed against gas companies. After providing that "every gas corporation shall charge for gas supplied a fair and reasonable price" it prohibits "an additional charge or fee for service or for the installation of apparatus or the use of apparatus installed." Neither the public or the lawmakers realize that if service charges are prohibited then the rates for gas or water or electric current must be raised and that it is difficult if not impossible to do this without overburdening some consumers and favoring others. Consumers regard the service charge as a device of the corporation to raise profits already extortionate. Unfortunately the service charge in the past has been and in some quarters even now is used as a means to this end; but not where there is sound public utility regulation. A vast amount of educational work, combined with impartial utility commission administration and whole-hearted co-operation by the utility corporations, will be required in some states before the public will cease to chafe under the service charge. Meanwhile, if legislatures or commissions forbid the service charge then its equivalent must enter into the unit consumption rates—a plan that for a long time to come will probably cause less friction than the other—if for no other reason than because it is not recognized by the consumer.

Concrete for Study

THE discussion on the behavior of concrete by the American Society for Testing Materials was distinctly worth while. Only a few hundred engineers were present and but a few of them took part but the printed record will be extensive and inclusive enough to carry emphasis where emphasis was sought. If the discussion serves to focus attention upon the characteristics of concrete as exhibited in service and not in tests, its purpose will have been achieved.

There was some misapprehension as to the effect of such a symposium and a disposition to regard it as an attack on concrete. Such could hardly be the case. With upwards of 125,000,000 bbl. of cement going into concrete this year there can be no question as to its secure position as an engineering tool. That very security is its own protection against unwarranted attack. Without portland cement and the concrete which it makes possible the civil engineer today would be thrust back a quarter-century in the solution of most of his problems. But because concrete has had a wonderful development is no reason to consider it a perfected product or even to consider that all of its specific failures to achieve perfection are due to misapplication of known methods. We are far from knowing all there is to know. The true scientific spirit of trying to learn more was behind the symposium and all concrete users will be benefited in the degree which they, too, can become possessed of that spirit.

This inquiry toward perfection, however, has two phases. One was represented by the group of men who took part in the symposium, men who are well acquainted with the extended investigations into the nature of concrete and its behavior in tests and, to some degree, in service and who therefore are disposed to consider that most deficiencies in concrete are due to the non-observance of established rules, but who at the same time recognize the gaps in present knowledge. The other, and more serious, phase is represented by the larger body of concrete users who, if the truth be told, are blandly ignorant of any but the elementary information of what concrete really is and how it should be made but who are in the end really responsible for a large part of the concrete that is placed. In this latter class are most of the concrete foremen, practically all concrete workmen and too many engineers and contractors who pride themselves on having placed thousands of yards of concrete and on their expert knowledge of its technique.

A reading of the discussion will show that the experts, with a few exceptions, lay most emphasis on an insistence on the rules of making concrete. It is acknowledged that there are examples of poor concrete which cannot be classed under any of the known

diagnoses; sea water and alkali exposure are particularly elusive. It is admitted that the optimum amount of water, not especially well defined at best, can rarely be used in real construction. There are certain peculiarities of aggregate which lead to trouble but which so far we have not been altogether successful in discovering or predicting. Density, or perhaps better impermeability of surface, the great desideratum, is easier to demand than to get. Study to supply these deficiencies is recommended but the major insistence is on observance of rules.

The one exception to that group is a smaller body of students of concrete who feel that there is great opportunity for a development in cement which will lead to a better concrete. This group was ably represented at the symposium by P. H. Bates, of the Bureau of Standards. Mr. Bates' discussion is a challenge to those who know enough about the nature of cement and the methods of its manufacture to discuss intelligently any proposals for its improvement. It must be admitted that few engineers come in that category, but engineers can appreciate the fundamental requirements for concrete laid down by Mr. Bates and the deficiencies of cement in meeting them. How to improve portland cement to make up these deficiencies or to devise a new cement which will be acceptable must be left to those in the cement industry and to the few scientists and specialists outside that industry capable of studying the problem.

It is clear, however, that the one standard for cement while a most necessary stabilizing influence in the development stage of that material need not be considered the ultimate aim. So long as concretes made from different cements all passing the standard specification react differently to the same conditions it cannot be said that we have a satisfactory specification. The only ultimate solution is either to devise a specification which does indicate similar prospective reactions or to formulate different specifications for differing material.

It is true, as Mr. Kinney pointed out, that the conditions of cement manufacture with its scattered plants so located as to serve certain territories with a minimum of haulage make a uniform product economically desirable; it is also true that a multiplication of standards would be confusing both to producer and consumer. But it is conceivable that one standard would cover the major part of concrete used and that the special types would be applicable to the concrete subject to the kind of exposure that has given the greatest trouble, such as for floors, extreme weather exposure, sea water and alkali. If cements better suited to these uses can be devised the additional cost due to special manufacture would doubtless be absorbed by the user. Meanwhile it is reassuring to hear from a representative of the cement manufacturers that that industry realizes the seriousness of this demand and is engaged in a study of the nature of cement and its methods of manufacture of greater scope and more serious intent than ever before attempted.

The other phase of this inquiry into concrete behavior is something which all concrete users may take to heart. In spite of the vast amount of publicity work that has been done there are many immediately responsible for the mixing and placing of concrete, and even of the selection of the materials which make it up, who pay no attention to what are acknowledged to be elementary rules for making concrete. This is due sometimes to ignorance but more often to poorly placed self confidence. The foreman who never saw a piece of concrete he supervised five years after he placed it goes serenely ahead putting in what he has established in his mind as "good concrete" without ever knowing whether similar "good concrete" placed in the past has stood up or is going to pieces. The disease extends sometimes higher up than the foreman. Its cure lies in publicity; in constant hammering by those who do know what can happen to bad concrete; in more attention to the actual mixing and placing of the concrete; in better supervision and better inspection.

The education of the ignorant and self-complacent and the study of the yet unsolved problems of cement and concrete will be both furthered by such discussions as took place at Atlantic City. Concrete is too valuable an asset to the constructor for him to be satisfied with its present development.

Warning the Coal Men

FAIR warning to both miner and operator is the keynote of the anthracite report of the President's Coal Commission. The public must be protected against exorbitant prices and the distress of shortage incident to strikes. The commission is evidently fair and tolerant, but it is clearly convinced of the public interest inherent in the coal business—the Supreme Court's opinion in the Kansas Labor Court case to the contrary notwithstanding—and its recommendations all look toward a protection of that interest. As was foreshadowed in the earlier report government regulation, not government ownership, is recommended. But that regulation is not to be mandatory unless the two contracting parties in coal production are unable to come to an agreement which protects the public in both price and delivery.

In such an emergency government control is recommended. At other times the governmental interference would be confined to an investigation of the degree to which the public is in need of protection, with power to act to remedy any "conspiracy of either operators or miners, or both, directed against the general welfare of the people."

There is no specific charge that anthracite coal costs the public too much, but there is intimation that reduction in freight rates, royalties and dealer profits can be brought about. The commission evidently hopes that the presentation of the facts—not all yet available—will be impressive enough to bring both operator and miner to a better appreciation of the public's point of view, under the increasing threat of ultimate government control.

The representative and yet diverse character of the commission inspires respect in its report. Everyone in the coal industry must accept that; they will do well to go about the readjustment of their business in line with the commission's recommendations with the realization that the public is in a mood to get coal when they need it and at a fair price. The commission gives the industry a chance to do this without much interference from the government. If the industry fails—and the commission wants legislation to make sure that the government will know when it does fail—there is little doubt that the public will step in to run the coal industry itself.

Flood Protection Plan Adopted by Pueblo District

Will Provide for Flood More Than Twice as Great as That of 1921—Channel Through City to Be Relocated and Retarding Basin to Be Built Upstream—Cost Less Than Damage of Last Flood

BY C. A. BOCK
Secretary, Dayton Morgan Engineering Co., Pueblo, Colo.

ON JUNE 2 the directors of the Pueblo Conservancy District adopted a plan for controlling floods as worked out by the engineering staff of the district. The plan and its underlying conditions are outlined in the following:

Flood Conditions—Pueblo is on the Arkansas River, at the eastern edge of the foothills of the Rockies, in southeastern Colorado. With 50,000 population it is the second city in the state. Its central part occupies the river flood plain, just above Fountain Creek.

Over three-fourths of the 4,800-square mile drainage area above the city is mountainous, while 1,000 square miles are valley and mesa land lying east of Canon City, between the Wet Mountains south of the river and the Pikes Peak uplift to the north. The slope of the river through Pueblo is about 12 ft. to the mile, increasing gradually upstream to 25 ft. at Canon City. For 800 ft. through the city the channel is lined by vertical stone walls about 17 ft. high above the river bed and 150 ft. apart, but the floorbeams of Union Ave. bridge.

CROSS-SECTION OF PROPOSED CHANNEL, LOOKING SOUTHEAST

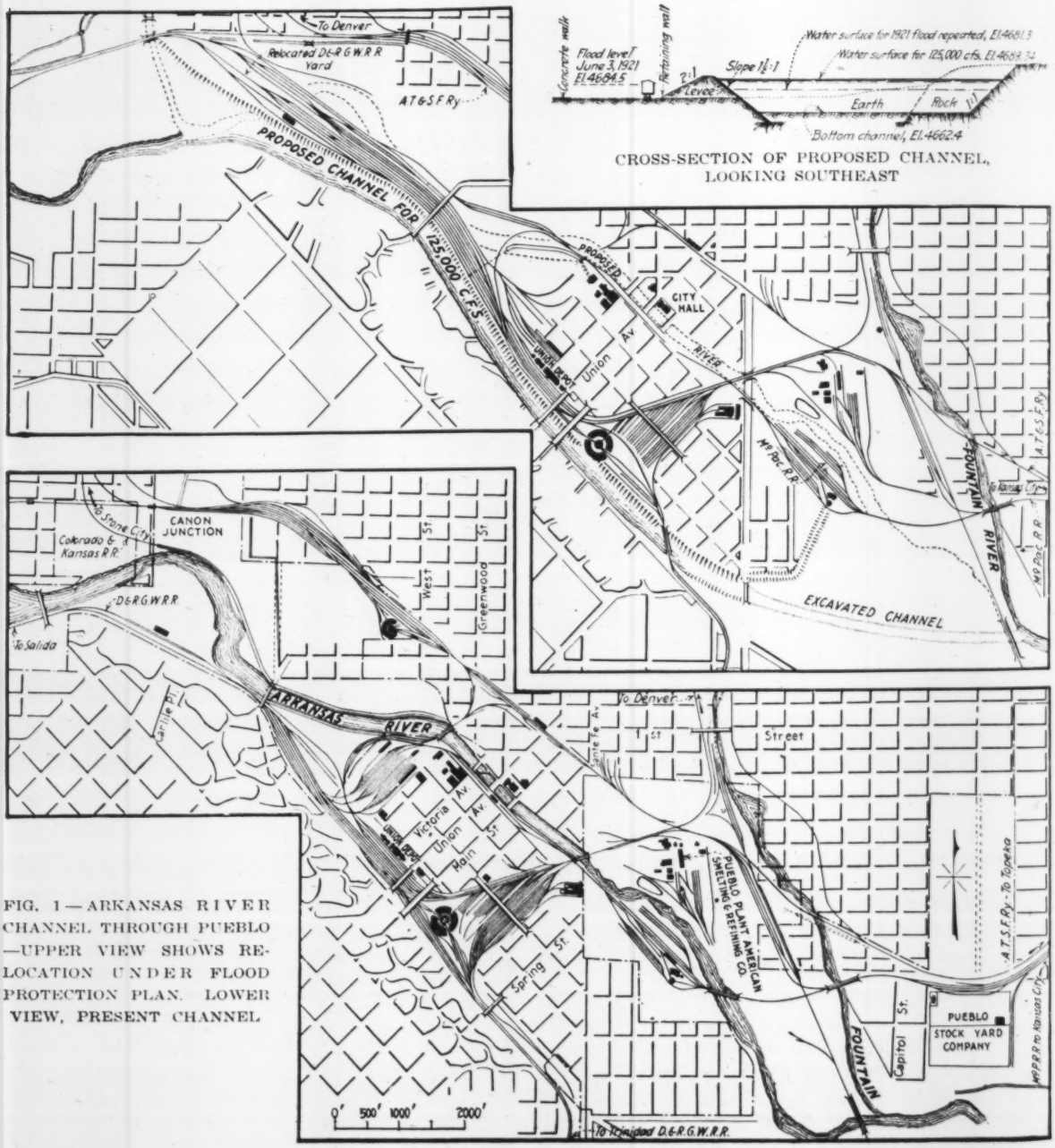

FIG. 1—ARKANSAS RIVER CHANNEL THROUGH PUEBLO—UPPER VIEW SHOWS RELOCATION UNDER FLOOD PROTECTION PLAN. LOWER VIEW, PRESENT CHANNEL

spanning this section, extend 5 ft. below the tops of the walls. The river bed is sand and gravel. Originally the river followed a winding course through its flood plain in Pueblo, but as the city grew it was slightly straightened. This straightened channel has a capacity of only 37,000 sec.-ft., while the maximum discharge of the flood of 1921 is estimated at 90,000 sec.-ft.

The 1921 Flood—The flood of June 3-5, 1921, was caused primarily by localized cloudbursts during the afternoon and night of June 3 over the mesas and in the foothills between Pueblo and Canon City, and was due to the runoff of less than 10 per cent of the drainage area above Pueblo. In the Boggs Flats district, about 15 miles southwest of Pueblo, more than 12 in. fell in 7 hr. or less; at Colorado Springs, about 45 miles north, 9.40 in. fell in 10½ hr.; and at Penrose, about 25 miles northwest, 7 in. fell in 17 hr., while the rainfall in Pueblo amounted to only 2.88 in. during 12 hr. In the Dry Creek drainage area, just northwest of Pueblo, a cloudburst possibly more intense than that of the evening of June 3 fell on June 2, but it did no appreciable damage at Pueblo. The rain continued at intervals in various parts of the valley during June 4-8, causing the failure on June 9 of the Schaeffer Dam, on Beaver Creek, about 30 miles northwest of Pueblo.

The main flood in the Arkansas River at Pueblo occurred during the night of June 3-4, the water beginning to rise at about 5 p.m. and reaching the crest of 24.7 ft. at the Main St. gage at midnight—a total rise of 20 ft. in 7 hr. Before 1 a.m. the river began to fall, and by 5 a.m. was down to about the tops of the levees. Fountain Creek, with a fall of 25 ft. per mile, had not reached appreciable flood proportions at 1 a.m., but developed a violent flood a few hours later, reaching a crest flow of 50,000 sec.-ft. at 4 a.m.

The flood runoff was confined to the territory below Canon City. No damage occurred at Canon City and practically none at Florence, 27 miles above Pueblo. Below Florence, the damage increased rapidly and was greatest at Pueblo, where the property damage is estimated at over $10,000,000. Hundreds of dwellings were swept away and many buildings were wrecked. The loss of life in the city was great; the official list of 78 bodies recovered doubtless fails to include all the deaths. Of the nine railroad bridges in the city, eight were either seriously damaged or completely destroyed; portions of the yards were badly wrecked or buried in sediment, and much equipment was washed away or seriously damaged. The intangible losses were very great.

Flood Possibilities—Indian legend tells of a flood much greater than that of 1921 which occurred prior to the settlement of the Arkansas Valley, probably in 1844. Newspaper articles together with statements of early settlers indicate that floods of considerable magnitude occurred in 1855, June 1864, May 1867, June 1869, August 1889, July 1893 and May 1894. The flood of June 11, 1864, seems to have been comparable in size with the flood of June 3, 1921. The flood of May 30, 1894, was the most destructive in the history of the valley prior to 1921; its maximum height was about 6 ft. lower than the flood of 1921, and surveys made by the city engineer at the time indicated that the maximum discharge was about 40,000 sec.-ft. Next in size was the flood of July 26, 1893, which reached a height about 10 ft. lower than that of 1921.

It is impossible to work out any very satisfactory flood-frequency relation from the brief records available for the Arkansas River. About all that can be said is that there have been three floods of 40,000 sec.-ft. or more at Pueblo in 75 years, or one in about 25 years, and that two of these may have exceeded 90,000 sec.-ft.

Far less is known about floods in Colorado than might be desired, and the determination of what constitutes a reasonable degree of protection is in the main a matter of judgment supplemented by studies and experience elsewhere. American storm rainfall records, studies of cloudburst rainfalls and of great floods in this country and in Europe, theoretical studies of the total amount of water which can be retained in the atmosphere and concentrated in any one locality under given conditions, and probabilities of various possible condi-

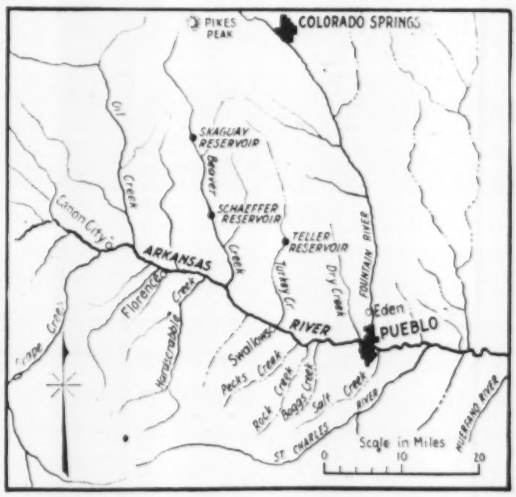

FIG. 2—PART OF DRAINAGE AREA ABOVE PUEBLO

tions and combinations of rainfall occurrence were considered in this connection. Thus, if the Boggs Creek cloudburst, which caused a discharge of over 55,000 sec.-ft. in the St. Charles River at 1 a.m. on June 4, had centered five miles farther north, this additional runoff would have been transferred into the Arkansas River and might have nearly doubled the peak discharge through Pueblo.

The conclusion reached was that the protection works should be made adequate to care for a flood two or three times as great as that of 1921, depending upon the relative duration and intensity of the rainfall causing the flood. Other requirements for a satisfactory plan were that the cost must be well within the resulting benefits; the construction should be as beneficial and of as little detriment to the city as possible; it should cause a minimum of disorganization and rearrangement; and it must be adapted to future requirements of a growing city. The railroad tracks and yards adjacent to the river were an important factor in determining the plan. The chief engineers of the various railroads held a number of meetings at Pueblo in an effort to assist in working out the problem, and further co-operated by making available maps, plans and data. All possible plans or methods of control were studied.

Adopted Plan—Fig. 1 shows the central part of Pueblo, as it is now and as the flood-control plan just adopted will change it. The business section centers roughly at the intersection of Union Ave. and Main St.

and extends southwesterly to the bluffs just beyond the Denver & Rio Grande Western Ry. yards. Fountain Creek, to the east, is separated from the business district by a prominent ridge, and joins the Arkansas River well below the city. The plan provides for moving the present Arkansas River channel in Pueblo to a new location along the bluffs at the south edge of the valley floor. It also provides a small retarding basin formed by the construction of a barrier at Rock Canyon, 6 miles above the city, for the purpose of regulating the flow of great floods before they reach Pueblo; the effect of this barrier is to cut off the peaks of extreme floods.

A disadvantage of the plan is that its first cost would be about half a million dollars more than the plan for a large retarding dam at Rock Canyon. Another possible disadvantage is that it disturbs the Denver & Rio Grande Western Ry. freight yards. Its advantages are depending upon the relative duration and intensity of the rainfall causing the flood.

The channel along the foot of the bluffs at the south side of the valley will extend from the mouth of Dry Creek, which enters the Arkansas River just above Pueblo, to Santa Fe Ave., where the Santa Fe Trail enters the city from the south, and will be constructed partly by excavation and partly by a levee along the left or north bank, the bluff serving as the other bank. The grade will be 10 per cent steeper than the average present grade, tending to a self-maintaining channel. From its lower end a small channel will be excavated through waste lands from Santa Fe Ave. to the present river channel at the Colorado & Southern Ry. bridge, for carrying the low-water flow eastward from the mouth of the deep channel.

Channel—The location, requiring a high paved levee

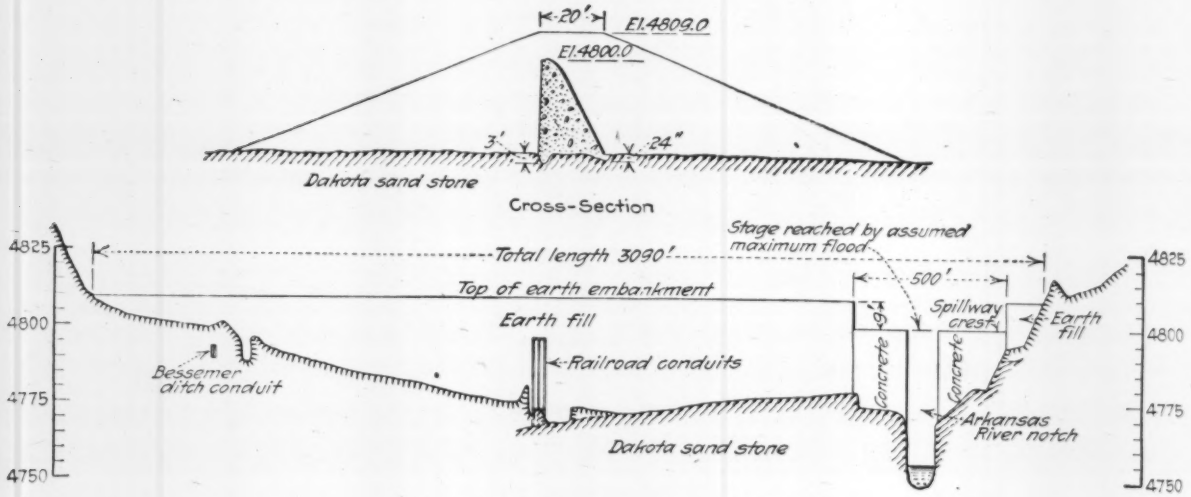

FIG. 3—ROCK CANYON RETARDING DAM

numerous. The physical conditions inherent to the new channel location are favorable both as to cost and as to the degree of protection. The protection it affords is, with one exception, equal to that of any other feasible plan; it gives positive protection against floods from Dry Creek; it improves the streets at their crossings of the present channel; it opens Santa Fe Ave., the main thoroughfare from the south, avoiding undesirable grade crossings at the present channel; it decreases the number of bridges to be maintained by the city, county and railroads; it benefits the railroads operating in Pueblo; it greatly improves the appearance and attractiveness of the city, and makes important improvements in the general arrangements that are conducive to future development and growth; and it improves the channel alignment.

Space is available for a wide channel between important railroad structures and the bluff. There are limits to the desirable width and depth and flow velocities, which have been recognized in the design; the further control which is necessary is accomplished by the retarding barrier above Pueblo. The greatest flow through Pueblo will be limited to 125,000 sec.-ft., made up of a maximum outflow of 100,000 sec.-ft. past the barrier, and a coincident flood peak of 25,000 sec.-ft. from Dry Creek. The plan will protect Pueblo from a flood two or three times as great as that of 1921, on only one side, and involving a levee height which does not obstruct travel, has made it possible to design the channel for deep flow. The bottom grade is a continuation of the river bottom above and below the city. With maximum flow there will be a paved freeboard of 2 ft. The present value of the waste land below Santa Fe Ave. is not sufficient to warrant the cost of protecting it. A channel only large enough for low-water flow will be constructed here, with the expectation that water will overflow during times of flood. At any time in the future the protection could be continued below Santa Fe Ave.

The main levee, forming the left or north bank of the new channel, begins at the easterly end of the proposed railroad bridge over Dry Creek and runs to Santa Fe Ave. A similar levee will form the right bank of the new channel at its lower end after it turns away from the bluff. These levees will have a top width of 8 ft., a land-side slope of 2 to 1, and a water-side slope of 1½ to 1; the latter will be paved with concrete to 2 ft. above the high-water line.

The levees extending up Dry Creek are too high to be crossed by the tracks west of the Denver & Rio Grande Western freight yards without causing undesirable grades within the yard. The tracks are therefore carried across the stream at a level 8 ft. below the levee tops on a heavy watertight concrete bridge having

sides built up to the levee grade and at the ends connected to the levees.

Railroad Changes—The plans for railroad work aim to give the railroads every advantage of rearrangement possible at a cost to the district not to exceed the damage to the railroads by reason of the property taken. Yards and tracks of the Denver & Rio Grande Western Ry. which must be moved from their present location along the foot of the bluff are replaced by a new yard north of the new channel, extending from the westerly end of the Union Depot tracks to Dry Creek. The north unit, or that comprising all but the southerly seven tracks of the new yard, together with connecting tracks and new ice-house tracks, are to be completed ready for operation before any existing tracks are disturbed. This change will also include the construction of a new 15,000-ton ice house, freight house, coaling plant and several new roundhouse stalls. The Union Depot tracks are slightly altered but the building is not disturbed. Five single-track railroad bridges across the present river channel become unnecessary under the changes effected by the plan.

Abandonment of the present river channel makes possible the replacement of the former Santa Fe Ave. highway bridge and grade crossings by a modern subway under the four railroad tracks. Four highway or street bridges are provided across the new channel, and one double-track railroad bridge.

Retarding Basin—At the site of the retarding barrier, the river runs through a gorge 60 ft. wide and 20 ft. deep in solid Dakota sandstone formation. The barrier will consist of a concrete spillway 500 ft. long between two concrete wingwall abutments, containing an open notch outlet at the gorge, and earth fill extending from the abutments to high ground at the sides of the valley. The outlet notch will be proportioned to discharge about 84,000 sec.-ft. under assumed extreme flood conditions. In addition, two conduits for the Denver & Rio Grande Western double-track railroad and one for the Bessemer irrigation ditch will discharge water during large floods; these openings are so designed that the combined outflow under the assumed extreme flood conditions will not exceed 100,000 sec.-ft. The spillway, provided as a precaution to insure absolute safety to the structure in case of a flood beyond the limits of probability, will be built on the solid sandstone formation.

Other Possible Plans—Other plans of flood control included relocations of the channel, complete diversion, combinations of channel improvement and a reservoir control, a single large retarding dam at Rock Canyon, a system of small reservoirs on tributaries, a 500-ft. channel along the bluffs with extensive improvement to railroad facilities, and a large parked floodway south of the river with a high levee along the north bank of the present channel. Excessive cost, physical difficulties of construction, and inability of the railroads to co-operate in financing extensive improvements to their present facilities, eliminated these plans in favor of the one adopted.

The adopted plan is ample for the conditions of any storm rainfall on record in Colorado or any adjoining state. If during the next hundred years a storm should occur anywhere within 500 miles of Pueblo which would indicate that a greater storm might occur than is provided for, the protection works could readily be enlarged to meet such conditions. The works will handle a comparatively long-drawn-out flood, such as might result from sudden melting of snow under rare conditions, by the capacity of the improved channel, and a very sharp, sudden flood, such as might be caused by the breaking of a dam at some irrigation reservoir, by the barrier. Any existing or probable future dam above Pueblo could break suddenly without harm to the City.

Present Status—Preliminary investigations and surveys for the project were begun by the Dayton Morgan Engineering Co. in September, 1921. The Colorado Conservancy Act, which provides the necessary legal machinery for carrying out the undertaking, was passed by a special session of the legislature in April, 1922. The Pueblo Conservancy District was established under this act in September of the same year.

The Pueblo project is the second large flood-control undertaking to be carried out under a conservancy law in this country, the Miami system of Ohio being the first. The successful organization and prosecution of these projects thoroughly demonstrates the workability of this type of legal procedure for handling such undertakings. The first conservancy law was the Ohio Act, passed in 1914. It was originally drafted by Arthur E. Morgan and combines the results of practical engineering experience with legal conformity in such a degree as to make it more generally useful for conservation and flood-control projects than many of the state drainage laws or similar previous legislation. The Colorado Conservancy Act is modeled after the Ohio Act.

Quantities and Cost—The project involved the following physical quantities:

Channel excavation	999,000 cu.yd.
River levee	489,000 cu.yd.
Miscellaneous embankment	134,000 cu.yd.
Earth in barrier	217,700 cu.yd.
Earth in r.r. yards	516,000 cu.yd.
Concrete in barrier	7,200 cu.yd.
Concrete in bridges, walls and revetment	42,850 cu.yd.
Bridge steel	2,915 tons
New tracks and yards	35 miles

Its cost is estimated at $4,000,000. It will be paid for by assessments on the benefited properties and interests, distributed over a term of years. Funds for construction will be available at once, however, through bonds of the district, issued on the credit of the appraisal roll when approved by the Conservancy Court.

Motor Car Service on B. & M. R.R.

Possibilities of motor-car service on branch lines are mentioned in the annual report of the Boston & Maine R.R. as follows:

The management has been in touch with the experiments made on various roads with gasoline motor cars adapted for branch line service. It has also conducted experiments on local branch lines with a steam unit car. These trials, although generally successful from a mechanical standpoint, have been interrupted for operating reasons and have not yet been conclusive. They have demonstrated that the field for such a type of car may be overestimated, as many branch-line runs are so involved with main-line runs or with freight, express and milk traffic that it is not possible to substitute single unit cars. It is evident, however, that as soon as a satisfactory car has been developed, it can be used to advantage at a number of points on the Boston & Maine, and this development is receiving the careful consideration of the management.

A Discussion on the Behavior of Concrete

Observations on the Service Record of Concrete Structures Under Varying Conditions With Suggestions As To the Lines For Future Study

At the annual meeting of the American Society for Testing Materials, the evening of June 29 was devoted to a discussion entitled "What Properties of and Methods of Making Concrete Require Further Investigation," with a subtitle note to the effect that it was intended to be a "discussion of the requirements of concrete to meet the many varieties of service conditions;—what can be learned from behavior of actual structures?" There is given here an abstract of the printed papers and some notes, not necessarily quotations from the oral discussion.

Introduction

By Frank C. Wight
Managing Editor, *Engineering News-Record*

This is a stock-taking discussion. It is an attempt to get away from the view of concrete as a combination of cement, sand, stone and water which possesses certain physical properties to be studied and to look at it in detached fashion as a material to perform a service.

This behavior of actual concrete structures has seemed to the Society's Committee on Papers to be of exceptional interest in the study of concrete as a material. Inductive tests and studies have led to a number of theories and principles of the manufacture and placing of concrete, the best of which are embodied in modern practice. It is believed that adherence to these principles will result in a stronger and more lasting concrete, but unfortunately only time can tell whether this is a fact, always assuming that there is no readily discoverable dead line in quality, above which concrete will be everlasting and below which it will be of the most temporary nature. Five years from now possibly, better ten or fifteen years from now, we can observe concrete structures placed under recorded conditions and check up on the principles that governed their manufacture. One purpose of the present discussion is to move the clock back ten or fifteen years, to attempt to discover from the behavior of existing structures of that or greater age what were the properties and methods of making that affected their present known condition, be it good or bad.

It is recognized that this will not lead to a complete answer to the question "How can we make the perfect concrete?" It is recognized that conditions ten or fifteen years back are hard to discover, and that the elements entering into both manufacture and wear are many and diverse and that deductions made from the discoverable data are not incontrovertible. But it is hoped that by building up enough data there may appear some common facts which can be related to common results and which will be useful in the development of future practice.

The scheme of the discussion is first to consider the constituents of concrete and its methods of making, in the light of the service requirements, to discover if possible wherein lie future possibilities in cement, aggregates and proportioning and mixing. This is to be followed by a study of service conditions in roads, in sea water, in alkali water, and under the normal attacks of weather, tying up the behavior in so far as possible to the kind of concrete actually placed.

* * *

Future Requirements of Cement

By P. H. Bates
U. S. Bureau of Standards

Portland cement must have certain properties to meet certain service conditions. We are going to condense these to three conditions under which resulting cement products will be used: namely,

Class I.—Those atmospheric conditions in which the product will not be subjected to actual contact with water after making, but be subjected to only the water vapor present in the air. In this class of products we have reinforced-concrete buildings and mortars used on the interior of structures, especially as the top coat of floors.

Class II.—Those conditions in which the product is subjected continuously or intermittently to contact with water of a fair purity or low in solids composed largely of sulfates. In this class we find the greater use of cement, for it comprises such uses as in roads, mass concrete, stuccos, sewers, drain tile, etc.

Class III.—Those conditions in which the product is subjected to the action of a solution of salts, especially sulfates. In this class appear concrete used in sea water and concrete used in those arid regions where the soils contain considerable amounts of sulfate salts, as our "white alkali" regions of the West.

Stone is not permanent. Any geologist will tell us that our kaolins are disintegrated granites and that water in certain places is very "hard" because of dissolved limestone. Hence, in cement and its products we are only properly concerned with a relatively permanent material—but a material which will give such adequate service, be it months or years, as coupled with its cost of installation and superiority of resulting product will justify its use.

Atmospheric Exposure—The uses indicated in our Class I may seem to be the least severe of those to which cement may be placed. But even if such is the case, it is quite evident that we are in need of much research before we have the ideal cement for such purposes. Flexibility in the use of cement entails the use of more water than we should use and consequently in certain ways—strength and shrinkage—produces an inferior product, although in other ways it is superior. But what has been done so far as the cement is concerned, to develop a cement which would possess a minimum strength reduction and a minimum increase in shrinkage with the use of increased amounts of water? We have not made any thorough or even preliminary investigation to see how the different brands of cement vary in these respects. It is now time to investigate the quality of brands exhaustively, as a preliminary step in a research tending toward developing a cement affected in the least by the use of large quantities of water.

Very closely connected with the question of excess water used to produce readily flowing concrete is that of a more "workable" one obtained without the use of water in excess or admixtures of any kind. But how many researches have we in which it has been attempted to find if we have any cements more strikingly "plastic" than the others?

All floor finishers will say that with all cements there are occasions when a non-dusting, non-cracking floor is obtained and that with certain brands the likelihood of obtaining a good floor is far greater than with others. But they are seldom sure when the desired result will be obtained, and no one has developed a test or tests that will predict this quality. A research that would show just what constituent or combination of constituents in the cement, or what phenomena in the reaction of water on these, or what physical properties of the cement, as hardness of particles or fineness of grain, produce the expected and hoped-for result, would not only enable cement to

regain a favor that it has lost in this use but would also reduce the cost of floors and materially increase the use of portland cement for such purposes.

It is believed also that this same research would solve the problem confronting road builders where or when a very low atmospheric humidity exists. A number of instances of trouble have been reported of roads cracking under these conditions before final set has been obtained—and the trouble has not been due to excess water or poor choice of aggregate or poor grading of aggregate. *The difficulty has been with the cement.* Here again our tests are at fault. We store all test pieces of cement under close to saturated humidity conditions before and during the time of set. But much cement has to set in an atmosphere under considerably less than 50 per cent relative humidity and cannot be protected from evaporation during this period.

It has been our duty to examine the veneering of a large number of steel and concrete frame structures and we have been surprised at the relatively larger numbers of failures of the veneer on the concrete than on the steel structures. Architectural terra cotta, stone, and brick veneer show failures of a type that lead almost conclusively to the deduction that the concrete by contracting has induced strains in the veneer that have crushed it, especially when setting of the latter has been faulty due to the lack of fully embedding the individual units in the mortar.

Our present "soundness" tests are supposed to determine "constancy of volume," but this is only very relative and not near to the degree of accuracy that we must have and will ultimately have for certain types of work.

Moist Exposure—A road saturated with water may freeze and in this condition be subjected to the action of a warm sun on one side while the other remains well below freezing. A sewer is subjected to the action of water at practically all times and yet somewhat more than 50 per cent of the cement is soluble in water. A thoroughly dry stucco may suddenly be subjected to a heavy or long rain and while saturated be frozen.

Note that the conditions here are somewhat different from those existing in the first class. It is assuming rather much to infer that a cement which will be successful under the first condition will necessarily be just as successful under the second. That we do need studies for making cement still more adaptable is realized when we examine roads or massive retaining walls or foundations or stuccos. We are confronted often with a large number of shrinkage cracks which furnish a very unsightly appearance and would seem to mark a condition which may be conducive to ultimate failure. This condition occurs even under the most careful cases of application so frequently that it must be considered as produced by some inherent quality of the cement.

Our "standard" tests for cement will not tell the whole story. The character of the grading of the aggregates and strength tests of the concrete are also insufficient. Our present methods only very roughly approximately enable us to predict the suitability of a concrete for any particular use.

Concrete through which water *constantly* percolates is doomed, but only locally at that point where the percolation takes place. Hydrated cement, the matrix of concrete, is just as soluble as limestone, in fact it is more soluble. It has been found by sad experience that water must be kept out of concrete and it is being done on all large jobs. With the prevention of the water percolating through the concrete, the latter is giving adequate service. But cement in itself can not be so changed as to make the concrete impermeable. Here is a condition which requires the joint proper use of all the ingredients of concrete, cement, aggregate and water, and when so used an impermeable concrete can be obtained.

Saline Exposure—Concrete when subjected to the action of the solution of certain salts, especially sulfates, has been found to give a service which has been adversely criticised. Yet it gives a far greater service and return on the investment of installation than any other material that might be substituted for it at less, equal or greater cost.

Again we feel that the major part of such studies must be confined to the cement. If we have a matrix unaffected or but very slightly affected by these solutions, then we must of necessity assume that we would have reached the ideal condition or at least have it in sight. For we now know enough about the quality and the grading of aggregates needed for such work to be able to make the proper choice in this respect without further study. But we have such a meager amount of information in regard to the resisting qualities of cement to such salt action that this field of study may be considered a virgin one. However, we must start not with the cement as it reaches the market, but go to the plant and still further to the quarry. We must know its entire history just as much as we must know the entire history of the concrete—assuming as is generally but erroneously done that the history of concrete starts with the delivery of the cement and aggregates to the job. We must know not only that it is a certain brand made at a certain plant but we must also know from actual observation how and from what it was made and this detailed knowledge must be obtained by some keen observer more skilled in making such observations than in making cement.

We must have tests of the cement which will give us values which are indicative of the different behaviors which cement reveals in service. However, when we have all these data we are only in the position to make concrete and feel assured that we have on file some observations which have in other cases been overlooked but which are essential. In the meantime investigations must be under way which will have for their purpose the determination of the course and the products of the reaction which takes place between the constituents of cement and water, how these are affected by the various solutions with which cement may come in contact and how the reaction may be affected by various proportions of the constituents or by the different physical characteristics under which they may exist.

There is no question but that a deductive study of concrete forces us eventually to conclude that we are grossly ignorant of cement; what it is as produced on a plant scale; what variations in ultimate quality we must expect in any plant's production from day to day; what is the nature of the reaction with water and how this reaction will deport itself in a variety of atmospheres and solutions. Some intensive work must be done that will solve these questions and enable us to produce the exact kind of cement we want at any time after having found out the kind of cement we must have for the case in question.

Those but casually acquainted with the industry are surprised that a product made to meet our present standards can be produced under such a set of widely varying plant procedures and equipment as now used. Though the product may be "standardized" it is quite evident that its methods of production are not. While it is generally believed that this wide latitude in methods does produce the same character of product, we are not convinced that such is the case, especially in view of the incompleteness of the methods used in examining the marketed product. At the present time the only incentive for study is the matter of needed economies in production, and the limited studies already made have shown the economic value of certain changes in methods—as the waste heat boiler. Furthermore, in this case it seems reasonable to believe that the required care demanded of the kiln operator, in order to insure a uniform delivery of heat to the boiler, has produced a change in the cement, more marked than is generally realized. Studies of the efficiency of the grinding apparatus, not only as to the relative operating costs of the several types of machines available, but extended, as they should be, to the efficiency of the resulting cements, would be of extreme value to both consumer and producer. How interesting would be an investigation on the properties of the resulting

cements in which the sole variable in the methods of production would be the use of wet or dry raw mixes! Fuel economy demands a thorough study of all available types of kilns and furnaces and of necessity such a study must include the question of the quality of the cement produced. May not such studies result in our specifying what methods of production are desired in addition to the physical properties, just as we now specify steel of certain physical properties made by open-hearth or bessemer process?

* * *

Proportioning and Mixing

By R. B. Young

Hydro-Electric Power Commission of Ontario

Under certain conditions, concrete mixtures can be designed by new methods of determining proportions to give the strengths sought. Under other conditions equally likely to be met with on the job, the methods will not give the results required.

More exact methods for measuring the raw materials of concrete on the job can be studied to advantage. Under average conditions, our present methods of measuring concrete materials, particularly in the case of fine aggregate, result in lack of uniformity in the concrete mixtures, and their inherent errors tend to produce undersanded and permeable concrete more susceptible to the action of destructive agencies such as frost, alkali or sea water. Present methods are also responsible for a great many cases where contractors have overrun their estimates for cement. A 10 to 15 per cent increase in cement requirements brought about by improper measurement of fine aggregate is not unusual.

Nor do we know all there is to be known about the laws governing mixing. The relationship between the time during which a concrete is mixed and its strength at a given period is fairly well established, but little is known as to the relative effectiveness of different mechanical mixers.

What do we know about the influence of plant layout and construction on proportioning and mixing concrete? For example, the arrangement of bin gates in stationary plants influences the absolute volume of aggregate in a measured volume, and this in turn influences the cement content and water requirements and thus the quality of the concrete. Again, with the proper consistency there seems to be a remixing action during the transfer of concrete through chutes. How much do we know about this? Are our methods of charging a mixer altogether satisfactory? They are, probably, when we consider only our present equipment; but equipment could be modified if experiments demonstrated that other methods gave better concrete or were more economical in materials and power.

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Concrete Exposed to Atmosphere

By P. J. Freeman

Consulting Engineer, Pittsburgh

A careful study of many concrete structures which have deteriorated under atmospheric conditions has led the writer to believe that most of the trouble could have been avoided if the engineers and contractors had drawn their specifications and handled the construction so that the concrete produced had the qualities necessary to meet the demands of that particular service. Instead of doing this, the required strength was used as the principal guide and little or no thought was given to other requirements, particularly impermeability, but it was assumed that any concrete having sufficient strength for the purpose would also be durable, regardless of the conditions to which the concrete was exposed.

Numerous examples could be cited, but one or two will serve to illustrate the point which the writer wishes to make.

A concrete dry-dock on one of our northern lakes was constructed at a cost of about a million dollars, using a mixture of one part of portland cement, three parts of sand and five parts of limestone. At the end of five years the inside or exposed surface began to disintegrate so badly that at the end of about six years at least thirty per cent of the entire inside surface had crumbled and spalled away to depths varying from one to six or eight inches. Horizontal cores were drilled from the walls, which were thirteen feet thick. An examination of these cores showed that, extending in for several inches from the exposed surface, the concrete was mostly sand and cement. In placing the concrete, care had not been exercised to make an impermeable surface, although the compressive strength of the concrete was entirely adequate for the load requirements. The alternate filling and emptying of the dock caused water to percolate into the porous or permeable concrete and the action of the weather, particularly freezing and thawing, produced the disintegration which continued to eat away the walls until extensive repairs were made. The outside of the dock had been back-filled with loose material, principally cinders, which permitted water to come in contact with the wall within a few feet of the top. Excavations to remove this back-fill were made and in no instance was any disintegration found, as the wall had been protected from freezing by the fill.

A similar example shows quite clearly the results of neglecting to consider impermeability as an important factor in the design of a large hydro-electric plant. The project was started about 1912 and after building part of the dam the project was abandoned until recently. The mixtures used were 1 : 2 : 4 and 1 : 3 : 6 of portland cement, river sand, and river gravel. The 1 : 2 : 4 mix does not show signs of serious disintegration, but the concrete of the leaner mixture is in very bad condition. The investigation has not been completed, but it seems to be another case of not having the concrete made to suit the particular class of service but designed only to furnish the required strength on the assumption that such concrete would be durable.

It is not necessary to discuss the effects of placing concrete in cold weather, except to observe that many jobs are spoiled because those in charge neglect to consider that concrete must be warm to set and that they have not satisfied this requirement by merely keeping the materials from freezing while being mixed and placed and for a short time afterward. A $300,000 reinforced-concrete building was built last winter under these conditions and when the first warm day came the concrete began to go to pieces, and it is doubtful if satisfactory repairs can be made to save the structure.

An entirely different kind of trouble was experienced in connection with the base of a concrete highway. The mixture used was one part of portland cement, three parts of river sand, and six parts of river gravel, which were tested and passed by the State Highway Department. The concrete was placed during the summer months and allowed to harden before the asphalt top was applied. After about two years it was necessary to make some repairs and it was found that the concrete was not firm and hard but could be easily broken up, and that the gravel was covered with a white deposit of calcium sulfate. After exposure to the air the concrete had a tendency to become hard. Inasmuch as all of the materials had been found to comply with the best modern specifications and chemical analyses of the concrete showed that the mixture was 1 : 3 : 6 as specified, it was not possible to draw definite conclusions and a more thorough study should be made of similar conditions with particular reference to the specifications covering the richness of the mix.

In every case the concrete disintegration mentioned, the cement was all tested and complied with the specifications of the American Society for Testing Materials.

Designers of concrete should realize that they must consider the atmospheric conditions to which the concrete will be subjected and eliminate from their design any features which would tend to cause or permit water to percolate into the concrete.

At the present time it is almost impossible to obtain the facts necessary to make a satisfactory investigation of any concrete structure that was built a few years ago.

If concrete producers will make more careful records and tests and exchange ideas concerning their troubles, the writer feels that it will take only a few years to eliminate most of the unsatisfactory conditions which now exist.

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Concrete in Roads

By A. T. Goldbeck
U. S. Bureau of Public Roads

It is difficult to conceive of any type of concrete structure which is subjected to a more complex set of influences than is a concrete road surfacing. Investigations of the past few years are just beginning to show us something of the stresses to which concrete roads are subjected by the many kinds of forces acting upon them.

The concrete is "cured" by the use of some means for keeping the surface wet, such as frequent sprinkling and with the use of a wet earth covering by ponding, by straw covering, and in the last few years by a sprinkling of calcium chloride which acts as a hygroscopic material. After a short period of curing, the moisture is allowed to dry out from the concrete, and, as has been well established, shrinkage now takes place and the concrete slab by contraction slowly moves over the subgrade. The forces of friction thus developed between the subgrade and the slab produce tensile stress in the concrete, and when this stress exceeds the tensile strength, transverse cracks form at frequent intervals. Changes in temperature of the slab also expand and contract it and cause it to slide over the subgrade, again producing compressive or tensile stress in the slab. During the day, the top surface is heated by the sun to a higher temperature than the bottom surface and naturally the slab is warped downward at the edges and corners. During the night the reverse is true; the corners warp upward. In many cases they actually leave the subgrade. During periods of dry weather, the top surface becomes quite dry, while the bottom surface is in contact with the more or less moist subgrade. Under such conditions the concrete might be warped and bent upward at the sides and ends. In the meantime the varying moisture conditions in the subgrade are swelling and shrinking the soil in a most non-uniform manner and the road is offered non-uniform support. When cold weather comes, the ground freezes. Very naturally the entire road is raised due to the expanding action of the frost, and if it happens that snow is cleared from the center of the road and is heaped up along the sides, the insulating blanket of snow prevents as deep a penetration of frost at the sides as at the center. The center of the road is then heaved more than the sides which then overhang their center support like two cantilever beams, and through overstress thus created, the slab is cracked down the center. Frost action within the concrete itself also must be resisted, and this requires a dense, strong concrete of low absorption. A number of natural influences then have been at work even before traffic is turned onto the road.

The heavy fast-moving loads of the present day produce high stress in concrete slabs under certain conditions. This is especially so with heavy fast-moving vehicles having well-worn solid rubber tires. Impact stresses are apt to be high and this is especially true in the vicinity of joints and on roughly finished spots in the road. Not only does this heavy impact produce high bending stress, but the local pressure on the immediate surface is considerable. There are concrete roads in which exceptionally poor coarse aggregates have been used largely as a matter of expediency, which are now showing signs of distress from the action of traffic.

When we add to all of these influences the troubles which are apt to occur due to the use of unsuitable materials, too much water, or greatly inferior workmanship, coupled with a design ill-adapted to the conditions of subgrade and traffic, the wonder is that concrete roads are capable of giving the most excellent service which, in general, they are giving under our present-day rubber-tired traffic.

Defective Design—The concrete road has had its share of failures due to the use of a design which has been ill-fitted for the traffic and subgrade conditions. There have been reasons for poor design in the past, for many principles are only now beginning to be recognized and understood, and moreover, our oldest concrete roads have witnessed an increase in variety and intensity of traffic such as has never been recorded in a similar period in history. Again, the phenomena in connection with the movement and accumulation of moisture in the subgrade and the action of moisture on various kinds of subgrade materials have never been given thorough study.

Defects Other Than Design—There are other defects occurring in concrete roads, some of which are of no particular importance, and others of which are quite serious. These defects as observed by the District Engineers of the U. S. Bureau of Public Roads, by their assistants and by the author are listed as follows:

1. Cracking:
   - (*a*) Transverse;
   - (*b*) Longitudinal;
   - (*c*) Diagonal cracking;
   - (*d*) Corner cracking.
2. Hair Checking of the Concrete Surface.
3. Surface Irregularities in the Pavement as Constructed:
   - (*a*) Due to lack of uniform consistency of the mix;
   - (*b*) High joints;
   - (*c*) Slumping of concrete on grades;
   - (*d*) Unevenness of side forms.
4. Settlement of the Pavement.
5. "Blow-ups" of the Pavement.
6. Slipping of Joints.
7. Spalling at Concealed Joints.
8. Surface Scaling:
   - (*a*) Due to fine aggregate;
   - (*b*) Too wet a mixture or excessive finishing;
   - (*c*) Calcium chloride curing;
   - (*d*) Freezing.
9. Surface Raveling.
10. Surface Wear.
11. Concrete Disintegration:
    - (*a*) Due to alkali;
    - (*b*) Defective materials.
12. Surface Pockets:
    - (*a*) Due to dirty aggregate, balls of clay, coal, wood chips, soft material.

Summary—With the possible exception of cracking, there is hardly a defect listed and described above which cannot be almost entirely eliminated from concrete roads through the use of proper design and construction methods, satisfactory materials and their intelligent combination.

Concrete for pavements must have high flexural and tensile strength in order to minimize the frequency of cracking, it must have high density to better enable it to exclude moisture; the aggregates must be well bonded together to resist the disintegrating action of traffic, and the mixture must be homogeneous in proportions and consistency.

Perfect concrete road building is an intricate operation which too often is entirely under the control of inspectors who are not well versed in the technique of materials or construction. They do not understand the great importance of careful attention to details. By all means, concrete road inspectors and, in fact, inspectors on other types of concrete construction should be schooled in the causes and effects in connection with the various operations under their control. It is absurd that millions of dollars worth of materials and expensive construction should be left at the mercy of any but the most competent of inspectors.

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Exposure to Sea Water

By S. C. Hollister
Engineer, Philadelphia, Pa.

Of the many structures of plain or reinforced concrete exposed directly to sea water for the past ten years, few are free from some degree of deterioration.

The nature of the deterioration of plain and reinforced concrete by exposure to sea water is distinctly divided into two classes: (1) The deterioration resulting from the corrosion of the reinforcement, and (2) the disintegration under certain conditions of the concrete itself. Both forms are found only above the level of complete immersion. Attack is found regardless of whether sea or fresh water was used for gaging; whether the structure was cast in place or formed of precast units; or whether construction proceeded in the open air or under water. The deterioration seems to bear little relation to the variety of mixtures usually employed in construction work. Faulty placing or excessively wet mixture, however, hastens the attack.

The attack on reinforced concrete begins with the corrosion of the reinforcement. No corrosion is found where

there is complete immersion. It begins just above the mean water level, in from two to five years after construction. A two-inch covering of 1 : 2½ : 5 mixture or richer will protect the reinforcement from corrosion by fresh water; but no concrete mixture in this thickness will protect the steel from sea water corrosion.

Due to the expansion accompanying corrosion, the concrete covering is split in the direction of the reinforcement. These cracks permit more ready ingress of the sea water and the attack proceeds with increasing rapidity. Splitting does not extend below low tide to any great extent, because corrosion does not take place there; instead, it progresses upward, not only within the wave or spray belt, but as far as salt-laden air is found. A satisfactory permanent protective coating for the steel which does not seriously reduce the bond has not yet been found.

Once a portion of the surface of the concrete has been spalled off, the sea water attacks the concrete mass in the same manner as in plain concrete structures.

The attack on plain concrete begins at the mean water line and extends in diminishing degree upward and downward from that level. It originates wherever the sea water can gain access to that portion of the concrete mass lying within the surface skin originally formed over the exterior of the structure. Sometimes this access is provided through a honey-comb, or through a layer or pocket of laitance; at other times it is provided through the removal of the surface skin by abrasion or frost action.

Once the sea water has reached the inner concrete, chemical disintegration of the cement develops. The matrix is softened in time to such an extent that the concrete can be scooped out with the hand. Magnesium chloride, and especially magnesium sulphate, in the sea water appear to be the principal agents of attack. Calcium sulphate in considerable quantity is formed; and this compound having no setting properties under the conditions, the mass may be washed away by stream or wave action. Mechanical abrasion and frost action hasten disintegration.

Chemical disintegration begins at once after the inner concrete is reached by the sea water. Marked disintegration has been noted in two years where honey-comb or laitance forms the path of communication. Carefully made structures two years old, so situated as to be subject to abrasion by floating ice, have shown well-started attack. In some cases, the concrete has been wasted away for a depth of from eighteen inches to two feet on structures eight to ten years old.

To date, little has been learned of a constructive nature concerning the arrest or prevention of this wide-spread attack on concrete marine structures, other than to armour them with treated timber, stone or paving brick. Little is accurately known of the chemistry of the concrete disintegration. Cements other than portland are advanced for marine use; but although each may have some instances of successful use, there is no well-defined conclusion of preference over portland cement. The lack of thorough understanding of all cements is a handicap in the solution of the problem.

* * *

Mass Concrete in Service

By Arthur P. Davis
Recently Director, U. S. Reclamation Service

The writer has had opportunity to examine many large masses of concrete such as dams and bridge abutments, either in a supervisory or consulting capacity, or as an observer during and after construction.

These observations are very convincing upon two points:

1. That where clear water can be made to glide over concrete without disturbing its velocity or abruptly changing its direction, there is no practical limit to the velocities that can be permitted without harm.

2. That concrete which is subjected to the impact of water under high velocity is rapidly eroded and that under such conditions the velocities must be very carefully limited.

Water carrying sand or grit will gradually erode good concrete if the velocity is high.

Exposure to Alkali

By G. M. Williams
University of Saskatchewan

In numerous instances, irrigation structures, foundations and other concrete works have shown signs of failure after short exposure to the salts in the soil. Various theories as to the cause of deterioration were advanced and it was first believed to be due to the crystallization of the soluble salts in the pore space of the concrete, which action was greatly accelerated by the use of poor aggregate and poor methods of preparation and curing. The problem was further complicated by the fact that not all concretes exposed to *apparently* similar conditions were attacked, tending to substantiate the theory that aggregates and workmanship were to blame. The possibility that the deterioration was primarily due to reaction between the salts in solution and constituents of the cement was also advanced but was not generally accepted owing to lack of experimental verification and the knowledge that materials and workmanship were of inferior quality in some cases.

Deterioration due to alkali has generally occurred in the arid or semi-arid sections of the Western states. The weathering and breaking down of rocks by long exposure to the elements has resulted in the formation of soil, and the salts of sodium, calcium and magnesium which were once among the constituents of the rocks are now found distributed throughout the soil, usually in greatest amount in the clays and shales. While most ground waters carry in solution appreciable quantities of one or more of these salts, it is in the arid regions that concentrations are sufficiently high to result in such waters being classed as alkali waters. In the humid region, heavy rainfall for many years has washed most of these salts from the soil, but in the arid and semi-arid districts, a smaller rainfall together with soils less easily drained have resulted in the conditions as now found. The excessive application of irrigation water, together with poor drainage facilities, has resulted in a gradual raising of the soil-water level which has brought about a high concentration of salts at the ground surface and a few feet below.

Investigations to study the cause of deterioration were started in those localities where the trouble was first encountered.

All of the investigations may be considered as establishing the first phase of the investigation—definitely fixing the problem—and demonstrating the fact that disintegration is primarily a chemical action, rather than a physical disruption, and indicating the variable factors and conditions which must be met in practical work. The second phase of the work involves the discovery of means, materials and methods for eliminating the possibility of disintegration in future work.

1. In many districts of the Western states and Canada there are areas where the salt content of the soil is high and concrete cannot be used with assurance of success.

2. Study of field conditions indicates that deterioration of concrete structures is almost entirely confined to regions where the sulphate type predominates. Good quality concrete is apparently being successfully used in chloride and carbonate soils.

3. Rapidity of disintegration varies directly as the sulphate concentration.

4. Where concentrations are permanently low, good quality concrete appears to have a life which fully justifies its use.

5. Concentration of salt in ground water may be extremely variable at points short distances apart. There also appear to be seasonal or yearly variations in some districts.

6. Concrete of high quality is most resistant to action High quality for exposure to alkaline conditions is measured by impermeability or resistance to passage of water through the mass under pressure. The one big factor necessary to secure low permeability is high cement content, so that high compressive strength can generally be

used as a criterion of low permeability. Consistency, within practical working limits, and gradation of aggregate are secondary factors in obtaining a concrete of low permeability.

7. Where alkali conditions are bad, the factor of safety against failure can be greatly increased by employing proper drainage precautions.

8. The employment of a membrane waterproofing may prevent action for a time at least, but such a method is not practicable under all conditions.

9. Portland cement, as now constituted, is inherently subject to attack by sulphates in the soil and ground water and the practical and final settlement of the alkali-concrete problem is dependent upon modification of, or the discovery of some material which may be added to, portland cement to make it immune to such action.

* * *

Oral Discussion

Duff A. Abrams, Structural Materials Testing Laboratory—The strength and resistance of concrete depends mainly on the water-cement ratio and not on the aggregate. Aggregate must be well graded, clean and structurally sound. Given that a strong and durable concrete can be made provided methods of manufacture are correct.

H. S. Spackman, Philadelphia—No encouragement is given to the manufacturer of cement to strike out on new lines so long as the user does not call for other than standardized cement. The user must be educated to his own needs in this respect. Portland cement is far from perfect. The durability of concrete depends largely on the binder cement because the aggregate when properly selected is quite permanent.

Robert W. Lesley, Philadelphia—From long experience in the manufacture of cement, particularly in the early days when more than fifty-seven varieties were made, it seems strange to hear suggested a reversal of the one standard toward the getting of which so much effort was expended.

W. F. Purington, New Hampshire State Highway Department—Study must be made of aggregate. In New England particularly there is danger from felspathic sands which are in process of decomposition. Much of this type of sand, however, is used in concrete. It is initially weak and there may be progressive disintegration. Furthermore, shape of sand is a factor of strength. Slaty or ferruginous schists are stronger than granular sands. This may be because the fibrous material interlocks. Microscopic study of sand is most necessary in determining strength.

R. W. Crum, Purdue University—The methods of manufacturing concrete should be studied. There is need for extensive research into fabricating methods. The art of placing is far behind the science of design. Unquestionably with this, too, should go more study of cement.

T. G. Campbell, J. N. Chester Engineers, Pittsburgh—Cited several cases of disintegrated concrete in bridge floors, filtration plants, etc. His firm feels it cannot prophesy that concrete will not deteriorate.

W. C. Hart, Portland Cement Association—Principal difficulty with outdoor concrete is the excessive use of water. There is evidence in study of existing structures that those built before the water transportation method of placing concrete was developed are in good condition. Numerous structures have been examined, particularly the Illinois Central bridges built in 1902 and the Illinois-Mississippi Canal structures built in 1893. All of these show excellent present condition. Danger today is the use of too much water and lack of proper curing. Most careful inspection is necessary.

R. S. Greenman, New York State Engineer Department—What is needed is production of a non-absorbent concrete. Concrete which will best resist frost action is the most permanent. Density of concrete will not always keep out water, because dense concrete may contain aggregate which is porous. Copings are the weak points in most concrete buildings. Why do they disintegrate? Because practice allows the poorest concrete to flow to the top or sides with no compactness.

J. J. Payne, City Testing Laboratory, Pittsburgh—Many bad cases of concrete street base failures in Pittsburgh. Investigations have not fully revealed the trouble. The practice of concreting is far ahead of the theory. It will not hurt to study it.

W. G. Atwood, Marine Piling Investigation—If we can make a stable cement and make a good concrete later from the cement the problem of concrete in sea water is solved. Portland cement of today does not meet Vicat's hydraulic index for sea water written a hundred years ago.

E. E. Butterfield, Chemist, Borough of Queens, New York—Described special attention given to concrete in sea water now being placed in Jamaica Bay Boulevard. This concrete, due to special precautions, has the remarkable density of 0.875 and tests 4,200 to 6,000 lb. Hopes that it will resist sea-water attack, but is not altogether confident. There are two examples in the Borough of Queens of concrete in sea water, one carefully made, which is resisting the attack, and one poorly made, which has quite disintegrated.

H. S. Mattimore, Pennsylvania State Highway Department—We can get the most education from failures, but we make a mistake in giving brief rules for making concrete. The concrete placer himself must be educated. Materials are not being tested the way they should be in most work. We must study something besides strength. Aggregates must be studied for more than their strength.

W. M. Kinney, Portland Cement Association—The greatest trouble with concrete today is the water content. Sooner or later proportioning will be on the basis of a fourth ingredient, water added to the cement, sand, and stone which are now noted in ingredients. Failures of concrete observed are mostly in surfaces and in appearance. The structures are still quite capable of sustaining the loads for which they were designed and for which they are used. A suggestion for various standards of cement would bring back the old days of the cement business which were economically unsatisfactory. With the great number of cement plants designed so as to reduce as low as possible the freight distribution of cement, there would be the greatest difficulty in manufacturing different kinds of cement, certainly not justified if the present cement will serve. So far nothing has been developed to show that the present method is not satisfactory. In construction the placing in the forms is the detail most neglected and the actual fabrication must be perfected in a wide degree.

R. L. Bertin, White Construction Co., New York—There are plenty of good rules for making concrete. The trouble is they are not observed. If the studies on concrete and the methods of making it could be enforced we would have less trouble.

R. J. Wig, Los Angeles, Calif.—There is little danger of plain concrete in sea water so long as full attention is paid to its constituents and manufacture. Reinforced concrete in sea water is a different matter, though with proper design the deterioration in the slender type of members even may be reduced, if not eliminated.

Ernest Ashton, Lehigh Portland Cement Co.—Attention should be called to the fact that the present activity in the study of concrete has been brought about most by the activities of the manufacturers who went far beyond the manufacture of the cement itself into a study of the concrete in order to perfect the material which the cement is used in. So far the manufacturers have been anxious to establish a standard for cement so they might know what they are making and devote their attention to making the one thing. This standard having been established and the methods of testing it having been established, they are now ready to enter into a more detailed investigation of the nature of cement and the method of improving it. Such studies are going on and it is hoped will result in some material benefit to cement users. These users should bear with the manufacturers during this study period. The problem is not simple and the solution is being honestly sought.

Building Intercepting Sewers and Siphon at Hammond, Ind.

Large Concrete Pipe in Deep Trench—Well-Points Drain Sand—Traveling Trestle Handles Excavation and Backfill

By J. B. Murphy
Engineer of Construction, Sewer Department, Hammond, Ind.

IN CONSTRUCTING a system of intercepting sewers at Hammond, Ind., features of special interest were the use of concrete pipe up to 9 ft. in diameter, well-points and pumps to drain the deep bed of water-bearing sand in which the sewers are laid, a trestle and cable-haulage system for handling the excavated material and backfilling, and the construction of a double-barrel siphon under the river. The construction plant and methods are shown in Figs. 1 and 3.

In the summer of 1922 contracts were awarded for the construction of the main intercepting sewers and pumping station of the new sewerage system, which

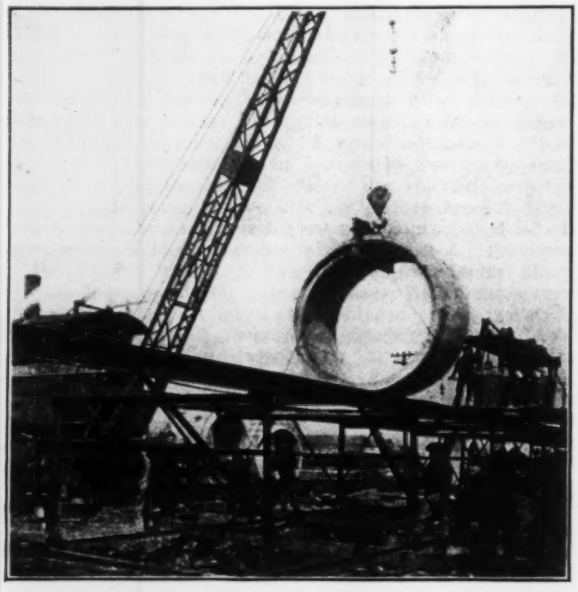


FIG. 1—CRANE PLACING 84-IN. CONCRETE PIPE

is of the combined type and will provide drainage for 4,680 acres or for all of the city except a portion recently annexed on the south side and that part near Lake Michigan called Robertsdale. The city is divided by the Grand Calumet River, necessitating the construction of two general sewer systems, each with an intercepting sewer and both interceptors delivering to one pumping station, from which the sewage is discharged into the Calumet River. There are about 6½ miles of intercepting sewer ranging from 24 to 108 in.

On the south side, the intercepting sewer varies from 54 to 108 in. internal diameter, and is connected to the pumping station on the north side by an inverted siphon consisting of two 60-in. reinforced-concrete conduits with a total length of 300 ft. and placed 56 ft. below the surface of the river. The north side intercepting sewer varies from 24 to 84 in., internal diameter and also discharges into the wet well of the pumping station, the bottom of which is 17.95 ft. below the surface of the river. A brick and steel building 52x148 ft. houses four centrifugal pumps and has space for two additional pumps when required. Two 20-in. electrically driven pumps, each of 20 c.f.s. capacity, take care of dry-weather flow; two 48-in. gas-driven pumps, each of 100 c.f.s. capacity, provide for storm-water flow.

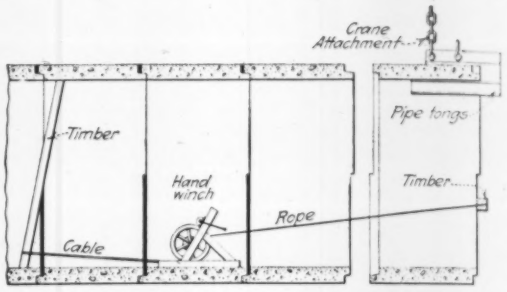


FIG. 2—HEELING PIPE INTO POSITION

The average depth of the sewers is 18 ft., in fine, water-bearing sand, the elevation of the water table being approximately 4 ft. below the surface of the ground and 14 ft. above the invert of the sewers. In the north portion of the city the water table is slightly above the surface of the ground. Under these conditions and since the discharge of the entire system has to be pumped into the river, at an estimated cost of $33 per million gallons per twenty-four hours, the question of infiltration became very important. Monolithic reinforced-concrete construction was considered in the original design for the interceptors, but it was later decided to use reinforced-concrete pipe for the following principal reasons: (1) In many sections of the country such pipe has been used successfully for conveying water under 10 to 50 lb. internal hydrostatic pressure, thus convincing the designers that its use was particularly adaptable for preventing infiltration; (2) the units can be fabricated on or near the site of the work several weeks in advance, allowing sufficient time for seasoning and affording adequate inspection before and after the units are installed.

The 108-in. pipe are 5 ft. long, with a 9-in. shell and weigh 8.6 tons each. They are installed by a 20-ton crane, as shown in Fig. 1, and the methods used in drawing them together are illustrated in Fig. 2. The units are laid to exact grade and levels taken on portions of the finished lines show that the elevation of the invert does not vary more than ¼ in., from the correct grade. Record runs of 100 ft. in eight hours were made during the extremely cold months of January, February and March, 80 to 90 ft. of 96-in. and 60 ft. of 108-in., pipe are average runs in eight hours. The lines are immediately backfilled as shown in Fig. 3. The joints are made tight by filling with neat Utica natural cement and oakum.

Rapid progress under the unfavorable conditions of soil and water have been made possible by the use of special construction methods. In order to remove the ground water from the trench, two 4-in. cast-iron pipe lines each 300 ft. in length are installed, one on each side of the trench (see Fig. 3), with gate valves 20 ft. apart on each line. At 4-ft. intervals on each line are located double hose-connections which are connected by means of 1½-in. hose, 3 ft. long, to 16 ft. lengths of

2-in. steel pipe driven vertically into the ground parallel to and outside the sheeting at 2-ft. intervals.

These drive pipes are provided with ordinary well-points 3 ft. long, which are jetted down to about 2 ft. below the invert of the sewer. The 4-in. main lines are connected across the trench by means of a 4-in. rubber hose. The ground water is removed through this system by the use of 7x8-in. triplex pumps, each fitted with vacuum gages and operating continuously, day and night. Experience has shown that it is necessary to keep the pumping system in operation for a length of trench representing a two-days' run and for 24 hours after the joints have been made so as to let the grout set. With the sand bed thus drained the working conditions at the bottom of the trench are very satisfactory.

Excavation to a depth of about 4 ft. is done by a dragline excavator and the trench is sheeted for this depth. Below this level the work is done by hand, the material being removed by a Potter plant consisting of ½-yd. buckets handled by a cable-operated car on a traveling steel trestle 352 ft. long, built over the trench. At the rear end of this trestle the material is dumped for backfilling.

This sewerage system was designed by W. F. Bridge, city engineer of Hammond, and by the writer, who is also in general charge of construction. The contract for the south side system and inverted siphon was let to the Proudfoot Construction Co., Chicago, which sublet the siphon work to the Subway Engineering Co., Chicago. The north side system is being built by the United Construction Co., Hammond, Ind., and the pumping station by Bates & Ahlborn, also of Hammond. The concrete pipe was made by the Independent Concrete Pipe Co., Indianapolis, Ind. The total estimated cost is $1,497,704, divided as follows: North Side system, $846,596; South Side system, $345,784; inverted siphon and gates, $78,000; pumping station, $227,324.

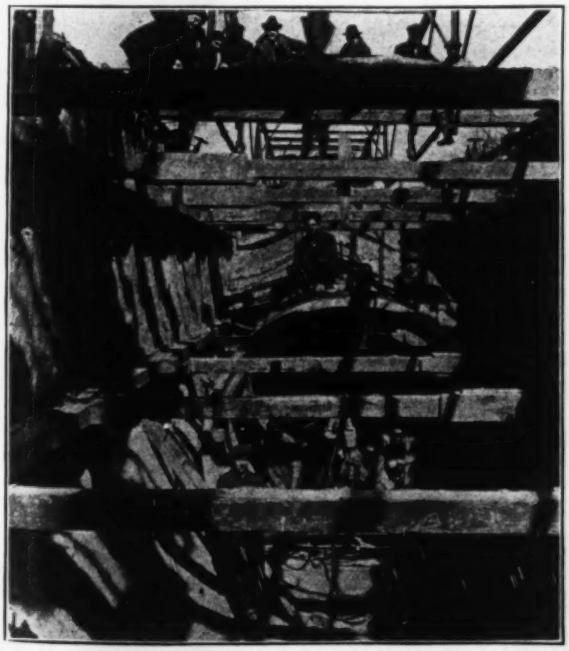


FIG. 3—SEWER OF 84-IN. CONCRETE PIPE IN TRENCH

Twin Tunnels for Sewer Siphon Under Calumet River

Shaft Lining Sinks with Cutting Edge—Pneumatic Tools for Heavy Clay in 6-Ft. Tunnels Steel and Wood Forms

AN INVERTED siphon under the Grand Calumet River at Hammond, Ind., is required to connect the new south side intercepting sewer with the pumping station on the north side, as described in the preceding article. This siphon, shown in Fig. 2, is composed of

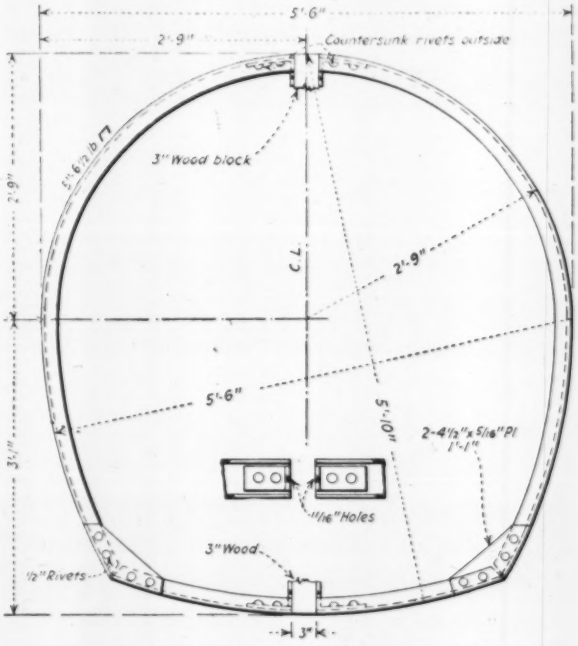


FIG. 1—STEEL FORMS FOR SEWER TUNNEL

two horseshoe tunnels 5 ft. 8 in. x 6 ft., two 11½-ft. shafts concreted to form two 5-ft. tubes in each shaft, an intake and an outlet chamber and two 72-in. and two 60-in. sluice gates with operating machinery. All the excavated material was used by the city for covering the sand formation in the public park, thus forming a good base for a soil top dressing.

Shafts—The shafts were 14 ft. in outside diameter and 11½ ft. inside the concrete shell. After about 8 ft. of sand and gravel the shafts were in soft clay which soon changed to hard dry clay of a shaly character; this latter disintegrated into thin horizontal layers or flakes when brought up and exposed to the air. Several seams of water-bearing sand were encountered, but only a little pumping was required since the shafts were not pumped out until the cutting edges of the forms had penetrated about 6 ft. into the clay. The depth from grade to tunnel invert was about 60 ft.

Steel forms in 5-ft. lengths were used for the south shaft and wood sectional forms in 8-ft. lengths for the north shaft. The cutting edge in each case was an angle 4x4x½ in. and a ¼-in. plate 18 in. deep with 3-ft. anchor bolts spaced 24 in. c. to c. At each shaft was a traveling derrick with double-drum hoist and 40-ft. boom handling a ½-yd. clamshell bucket. The shafts were sunk by open dredging to the top of the tunnel

and were underpinned from that level to the bottom. Several small cavings or wash-ins occurred in the south shaft, owing to old bed springs and other obstructions being caught under the cutting edge and carried down with it, thus forming a path on the outside of the shell for sand and muck to follow and wash under the cutting edge. In the north shaft there was little trouble. As each 5-ft. or 8-ft. length was sunk the shell spades or chisels were used. Muck was handled in ½-yd. steel dump-cars on tracks of 14-in. gage with 12-lb. rails on 4x4x30-in. ties spaced 3 ft. c. to c. These cars were handled on an elevator 5x4½ ft. in the south shaft, both tunnels being driven from this shaft to within 10 ft. of the north shaft and then completed from the latter. Gravel concrete was used, of 1:2:4 mix. In cold weather, the water and sand were heated, and for the

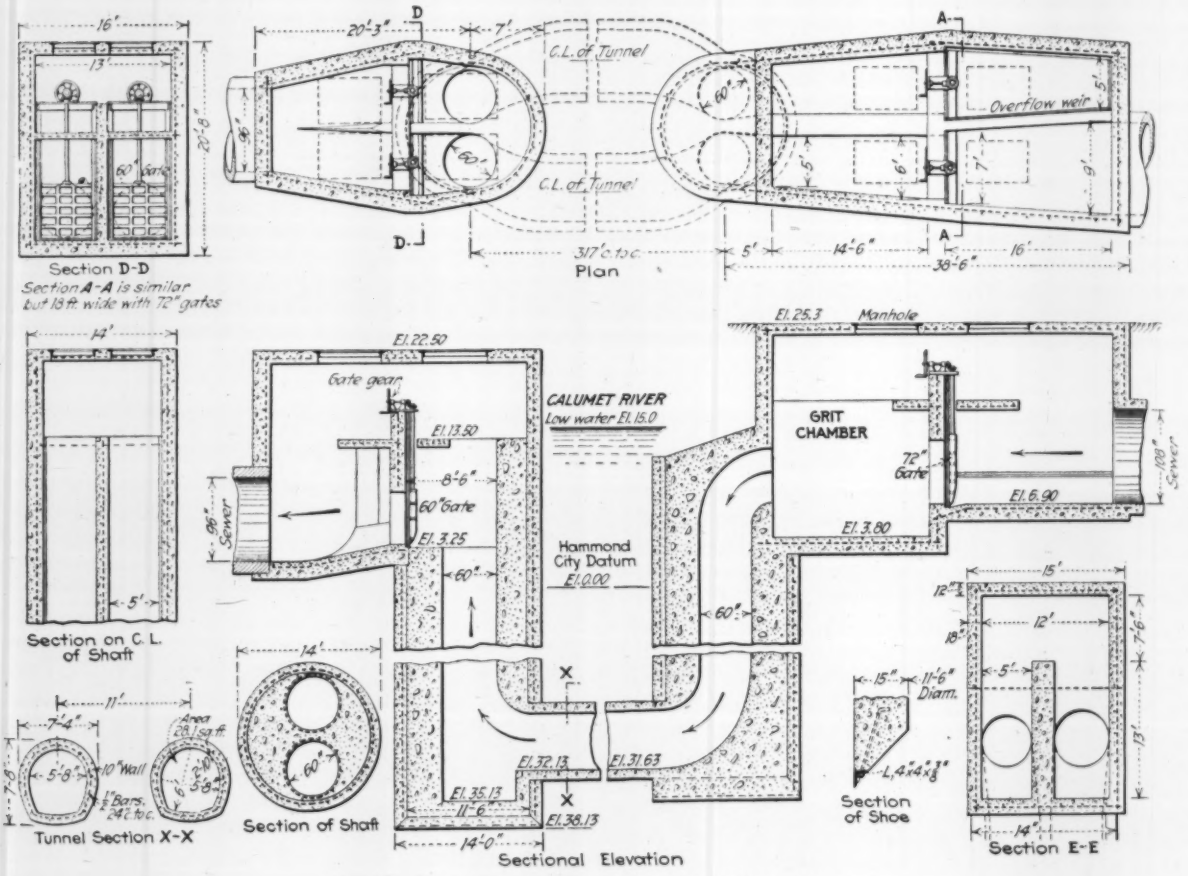


FIG. 2—SEWER SIPHON, TWIN SHAFTS AND TUNNELS

was concreted and the concrete was allowed to set for 48 hours before the excavation was continued, the shell going down with the cutting edge.

Tunneling—Tunnel excavation was mainly in the hard blue clay, which was dry but contained some boulders and numerous pieces of shale and slate. In this material the ordinary method was to mine 6 ft. and place the concrete lining. This operation was completed in nine hours, so that with two shifts the daily progress for each tunnel was 12 ft. Several sand pockets were encountered and some of these contained water. At these points the tunnels were timbered and the mining and concreting was done in 3-ft. sections. Steel forms were used, as shown in Fig. 1, each rib consisting of two 5-in. channels for the ribs with angle-iron lugs at top and bottom. The lagging was 2x6 in. with beveled edges, and was in 6-ft. and 3-ft. lengths. Each rib was set up by means of a 3-in. wood block at the crown and another in the invert.

Grub hoes and knives were used in driving the first 30 ft. of each tunnel, after which compressed-air shaft lining about 2 lb. of calcium chloride per bag of cement was added to hasten the setting. Cofferdams were built for the intake and outlet chambers, the water being taken care of by use of well-points and electric pumps.

Lines for the tunnels were furnished by the contractor, being transferred to the headings by means of piano wires and heavy plumb-bobs suspended in the shaft. Grades were given by the city engineer. The south shaft was begun Dec. 16, 1922, and completed Jan. 16, 1923. The intake chamber and 60 ft. of tunnel were excavated in February. In March, both tunnels were driven and concreted for 450 ft. In April, the tunnels, north shaft and outlet chamber were completed. The Subway Engineering Co., Chicago, had the subcontract for the siphon, the general contractor for the sewer work being the Proudfoot Construction Co., Chicago. Its price was about $77,000, including the gates.

Ernest A. Clark, member of the Subway Engineering Co., was in direct charge of the work.

To Increase Safety of Traffic on Highways

H. E. Breed Submits Recommendations in Committee Report to National Highway Traffic Association

RECOMMENDED practice to increase the safety of highway traffic, particularly at curves, was embodied in the following report submitted May 10 to the annual meeting of the National Highway Traffic Association by a committee consisting of H. Eltinge Breed, consulting highway engineer, New York City, chairman, W. G. Thompson and W. M. Acheson.

Safety on the highway is a matter of national concern. During this last year 14,000 lives have been sacrificed in automobile accidents. There are now registered in the United States 12,000,000 motor vehicles. This year's increase to that number is estimated by manufacturers at 3,000,000 The risk to safety lies in the congestion of 90 per cent of these vehicles upon 10 per cent of our roads. This risk we must minimize. That it is at present fraught with appalling loss of human life is evidenced by the casualties from automotive vehicle accidents—a loss yearly greater than by all other means of transportation combined.

The majority of these accidents of congestion occur under five conditions, all of which road builders may help to eliminate.

1. Sight distance on curves, both horizontal and vertical, which is insufficient to permit precaution against the other man's reckless driving. Lack of sight distance also increases accidents at intersecting roads and railroad crossings.

2. Insufficient width of pavement, especially in congested districts, which increases the number of cars that turn over on soft shoulders and roll down unprotected slopes. Narrow, or single-track bridges are a constant menace. In the design of roads 10 ft. should be allowed as a minimum width for each single line of traffic each way and 9 ft. more for each additional line each way.

3. The inadequate, irregular and improper spacing of danger signs which encourages a general carelessness of their import. Judged by the number of accidents in their vicinity, they are a spur to the recklessness of the joy-rider and a consequent risk to his sober brethren.

4. The tendency of detours under traffic to become almost impassable. On heavy-traveled routes traffic going in different directions should be routed over different detours, or, if detours are inadvisable on account of dangerous or impassable conditions, the road should be built horizontally a half at a time.

5. Railroad grade crossings.

Four Methods of Attack—To help prevent accidents to which these and other highway conditions are conducive, we may proceed at four points: First, to secure good design for new roads; second, to promote adequate improvement of old roads; third, to insist upon reconstruction of existing roads at places that have proven especially dangerous such as grade crossings, approaches to bridges, etc.; fourth, to improve the location of the center line on dangerous curves and elevations. Under these headings the following recommendations are made. They aim to promote the safety of the traveling public as far as impersonal factors can do it, and they aim to diminish as far as possible the personal menace projected by the reckless driver. Safety for the careful with protection from the careless.

Under the consideration of general safety for traffic comes the necessity of standard practice throughout the country in respect to placement of danger signals, elevation and banking of curves, widening and regulation of traffic on curves. Standardization in these matters is imperative because with the completion of transcontinental routes there is increasing interstate traffic. Drivers traveling to remote sections cannot be expected to apprehend distinctions in practice now existing between different highway departments, yet departure in one state from what they have become accustomed to expect in others is a frequent cause of disaster. There is no real obstacle in the way of this standardization; it is merely a matter of agreement among state highway officials and motor organizations.

Recommendations—Your committee has amplified the resolutions that you passed last year. They now stand:

1. On all curves of more than 3 deg. the pavement and inner half of the earth shoulder should be banked. This superelevation should vary from 0 for a 3-deg. curve to 1 in. per foot of width for curves of 20 deg. or sharper.

2. On all curves of more than 4 deg. the pavement should be widened on the inside ½ ft. for each 1 deg. increase in curvature. The widening and banking on a 4-deg. curve should start at a minimum of 50 ft. before reaching the P. C. and come to the fully widened and banked section at or very soon after reaching the P. C. Inversely, the regular section should be reached at a minimum of 50 ft. beyond the P. T.; for a 20-deg. curve, this varying or transitional width should be about 150 ft. long, with proportional lengths for intermediate curvatures.

3. A line about 4 in. in width and of an appropriate color should be painted on the center line of pavement on all curves, both vertical and horizontal, this painted line to be renewed as necessary in order to keep it conspicuous so that it may indicate to traffic in each direction the limit of its half width of pavement.

4. All sharp or dangerous curves, either simple or reverse, horizontal or vertical, should be posted about 500 ft. from each end with a sign indicating that danger exists. Railroad crossings at grade should be posted in a similar manner.

5. The National Highway Traffic Association recommends to all legislative committees preparing motor traffic laws that the attempt to pass a motor vehicle while going in the same direction on a curve, either horizontal or vertical, where the unobstructed line of vision is less than 500 ft., be made a misdemeanor; all damages resulting from an accident under these circumstances to be placed upon the passer.

6. The minimum radius of curves should be 1,000 ft. unless prevented by an approach to a bridge not practicable to change or an improvement being made on village or city street, even to the end that new right-of-way should be procured in order to increase the radius, bearing in mind that the improvement is being made for a long time, and that land values may increase to an extent that might prohibit procuring more right-of-way.

7. Providing there is sufficient space within the right-of-way, earth slopes should be carried out with a 4 on 1 slope. If this is not possible a guard rail should be placed on the inner edge of all curves of more than 8 deg. This rail should be kept painted white and be about 4 ft. in height.

8. In order to prevent the shoulders adjacent to hard-surfaced pavements from being gouged out, gravel or crushed stone, 1½ in. and 2½ in. size, mixed and filled with screenings, should be placed 2 ft. in width and 4 in. in depth on each side, maintained at the level of the pavement. An application of hot tar or asphalt on this gravel or stone will be found beneficial.

9. For public safety all advertising signs and obstructions along highway routes should be eliminated *except those erected by direction or permission of officials having jurisdiction over the highways and for public benefit.*

10. A definite sum should be set aside annually by each highway department, and a comprehensive plan devised on which annual progress is made, for the elimination of the most dangerous grade crossings.

11. Everyone who drives a car should be instructed by some competent person in the common courtesy usage and legal road rules.

12. There should be cleared away wherever possible all stone walls, brush, trees, banks, etc., on the inside of curves where it is impossible to obtain a sight distance of 500 ft.

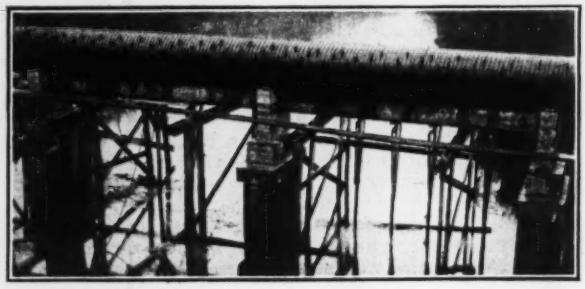
13. All single-track bridges should be widened to double-track, and every community, through surveys by proper officials, should ascertain the conditions of and on its bridges to carry safely loads up to the legal limit.

14. Where conditions warrant proper sidewalk provisions should be made and where sidewalks are provided it should be a misdemeanor for pedestrians to encumber the roads.

Allocating Concrete, Cast Iron and Wood Stave in a Pipe Line

All Three Kinds Used in 18½-Mile Conduit Bringing Water to Norfolk, Va., From a New Storage Reservoir

CONNECTING the new 4-billion-gallon Lake Prince storage reservoir of the Norfolk water-works with the filtration plant of the city, is an 18½-mile conduit of 30- and 36-in. pipe line made up of 2½ miles of cast-iron pipe, 10 miles of wood-stave pipe and 6 miles of concrete pipe. Protests against the use of anything but cast-iron by citizens led the engineers to study the route of the line carefully to obtain comparative figures bearing on the financial outlay, carrying capacity, leakage and desirability. The result was that all three were used—wood-stave wherever the local conditions were entirely favorable to its durability; cast-iron where conditions were not favorable to use of wood-stave or concrete, such as a summit approaching the hydraulic grade line and at river crossings; concrete, where conditions permitted and the working head would not



WOOD-STAVE PIPE ON CONCRETE BRIDGE OVER CREEK

exceed 150 ft. In a paper presented recently before the Virginia Engineering Society, William H. Taylor, III., city engineer, gave the following analysis:

Assuming the first cost of the wood-stave pipe of the required diameter and designed for a certain pressure to be unity, then the relative cost of the reinforced-concrete and cast-iron pipe of the same diameter and designed for like pressure would be represented by about 1.7 and 2.4, respectively. Corrected for carrying capacity, leakage and durability, based to some extent on experience with a local wood-pipe line, the relative costs of 1, 1.7 and 2.4 were corrected to 1.6, 1.7 and 3.4, respectively, considering every known or estimated advantage or disadvantage possessed by any one of the three pipes over the other two. It was therefore decided to use cast-iron pipe only where it was impracticable to use either the wood-stave or concrete pipe.

On the summit referred to, and less than two miles from the dam, a surge tank 10 ft. in diameter and 125 ft. high has been built, as a vent for entrained air, a pressure regulator, and a safety device against vacuum troubles.

The supply line has comparatively few curves of any magnitude, either vertical or horizontal, but the country varies from cultivated fields to swamp land, forest and rivers. Four major streams extensively navigated were crossed by submerging the pipe, and fourteen minor waterways were crossed by exposing the pipe and supporting it upon concrete piers on piles above the stream or bog. A right-of-way 30 ft. wide has been purchased throughout the length of the line, providing the means for future development. The submerged river crossings were described in *Engineering News-Record* of Sept. 7, 1922, page 393.

Venturi meters will measure the delivery of water into the line at the dam, and out of the line at the filtration plant. Near the ends of each section of concrete pipe

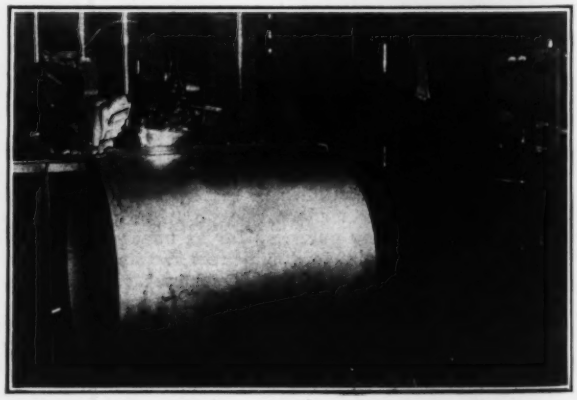
LAYING CONCRETE PIPE WITH A PORTABLE GANTRY

Pipes were handled on the job by caterpillar tractor and special low-hung trailers with plenty of clearance between front and back axles to permit rolling the pipe off sidewise.

brass rings 24 in. long were inserted (precast in a section of the pipe) for use as permanent pitometer stations. These rings were machined smooth and accurately calibrated. By means of pitometer readings at these points, together with accurate pressures ascertained, reliable determinations of the value of *C* in the Chezy formula are expected, as well as information as to leakage in the different kinds of pipe under service conditions. Static pressure tests indicate a leakage of 83 gal. per inch of diameter of pipe per mile per day for the concrete pipe and 310 gal. for the wood pipe.

The concrete pipe has 4-in. walls and was cast in 12-ft. lengths. Midway of the wall is a steel cylinder with electrically welded seams, riveted and lead-calked to cast-iron bell and spigot end rings. The rings were turned, a groove was provided in the bell and a taper was given to the spigot ring. A special lead ring gasket inserted in the groove was tightly compressed when the spigot end was drawn "home" beyond and over the tapered section of the spigot ring. The 2 in. of concrete outside of the steel cylinder was reinforced with woven-mesh wire.

The Redwood Manufacturing Co. of San Francisco manufactured and laid all of the wood-stave pipe. The Lock Joint Pipe Co. did likewise with the concrete pipe, and the Lynchburg Foundry Co. made the flexible joint cast-iron pipe. Col. Dabney H. Maury was consulting engineer on this work, which was designed and carried out under the general direction of the writer with Norman Z. Ball as designing engineer and David A. Decker as assistant engineer in

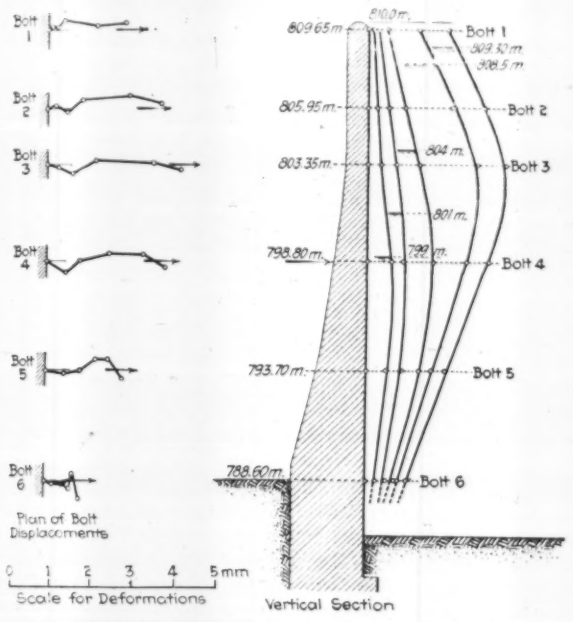


ELECTRICALLY WELDING A LONGITUDINAL SEAM

charge of construction of the dam and pipe line. W. R. Galt, John O. Miller and John N. Vaughan were resident engineers.

Deformations of Arched Dam Measured by Triangulation

LAST year the geodetic department of the federal survey bureau of Switzerland undertook to measure by triangulation the deformations of a small arched forebay dam. The work was done at the request of the electric traction division of the federal railways and had the main purpose of determining whether accurate and consistent results in such measurement could be obtained by survey methods. According to a report of the work in the *Schweizerische Bauzeitung* of Jan. 20, the results showed the method to be wholly successful. In fact, triangulation proved somewhat more satisfactory than direct sighting on a scale attached to the crest of the dam and read from an instrument set up



DEFORMATION MEASUREMENTS OF ARCHED DAMS

on a line tangent to the curve of the dam at this point, a method applicable only to readings at crest.

The dam under test is a stone masonry structure of pure arch type located in the valley of the Reuss at Pfaffensprung. It is 70 ft. high and in its main portion 100 ft. in span, with radius of curvature about the same. For the deformation measurements, six bolts were set in the downstream face of the dam about on the line of the crown of the arch, one at the crest, one at base, and four at intermediate levels. Instrument piers were erected on either bank, on rock, close to the abutments of the dam, and a third pier was provided on one bank 40 or 50 ft. upstream of the abutment, to give a sighting line nearly tangent to the curve of the dam at its crown; the latter pier was used for direct reading on a scale attached to the dam crest, while the two other piers, from which the bolts in the face of the dam were visible, were used for the measurements by triangulation. The measurements were carried out at five different water stages, ranging from half the height of the dam to full height. Atmospheric conditions were favorable (sky overcast) and the small size of the reservoir permitted the entire series of measurements to be carried out in a single day. The results are sketched in figure herewith.

At the left the triangulated displacements of the six bolts are shown in plan. At the right are plotted the deformation profiles of the wall in vertical section. The maximum displacement, it will be seen, was 3.3 mm., which occurred about 6½ m. below the crest. The crest displacement at full reservoir was 2 mm. The direct-reading measurement of this displacement was 2.2 mm., but the report credits this reading with a possible variation of ± 0.5 mm. The work as a whole is considered by the geodetic bureau to establish the suitability of the triangulation method for such measurements. As the bolts in the face of the dam and the instrument piers will remain in place, future measurements can be made at any time to give a check on the permanence of position and form of the dam.

A 12.76-In. Rainfall in 4½ Hours at Beaumont, Texas

A RAINFALL of 12.76 in. in 4½ hr. was recorded at Beaumont, Tex., on May 18. Through the courtesy of P. C. Day, meteorologist in charge of the Climatological Division of the Weather Bureau, Washington, D. C., the following details of the precipitation for the 12 hr. that included the period of excessive rainfall already noted are made available.

The total rainfall at Beaumont, Tex., from midnight, May 17-18, to noon, May 18, 1923, as measured by John Bender, river observer, Weather Bureau, was 13.54 in. The rainfall measurements are made at Beaumont in an ordinary 8-in. gage at 7 a.m., daily. The amount measured up to 7 a.m. of May 18 was 0.78 in., falling between the preceding midnight and the hour of observation. It is believed that practically all of this amount was gaged between 6 and 7 a.m.

A special reading of the gage was called for from this office (Houston) and made at 11:30 a.m., showing a catch of 12.76 in. during the preceding 4½ hr., the heaviest of which occurred between 7 a.m. and 9 a.m. It is believed that practically all of the amount measured on the 18th, 13.54 in., occurred between 6 a.m. and 11:30 a.m., and most of it between 6:30 a.m. and 9 a.m.

The first estimates of damage done by the excessive rainfall in the city of Beaumont were placed at $100,000. "Downtown streets were flooded, trees were struck by lightning, an oil tank caught fire, and the city government suffered serious losses as a result of the Beaumont downpour . . . Water was more than a foot deep in Pearl St. stores, and business was badly handicapped. The rain began falling (heavily) about 6 o'clock and continued in a terrific downpour until shortly before noon. Automobiles were stranded on many of the downtown streets. Hail accompanied the storm. . . ."

Considerable wood-block street paving was floated off during the storm and the storm sewers were inadequate to carry off the water. No lives were lost and the damage seems to have been extremely light in view of the phenomenal rainfall in so brief a time. The excessive rainfall was confined to a small area, with Beaumont as its center, near the mouth of the Neches River. This fact prevented any appreciable rise in the Neches, the stage on the gage being 3.8 ft. at Beaumont on the 17th and reaching a crest of only 4.8 ft. on the 20th.

Railway Trestle in Hawaii Fails

By B. F. Rush
Inspector of Construction,
Board of Harbor Commissioners, Hawaii

IN MARCH of this year ten bents of a trestle of the Hawaii Consolidated Ry. at Hilo, Hawaii, one by one upset and disappeared into the Wailuku River, each bent falling against and upsetting the adjoining one. The trestle was constructed in 1910. The bents consisted of two cylindrical reinforced-concrete posts 3 ft. in diameter, and a reinforced-concrete cap. In all there were 23 separate bents at 16 ft. centers. Each bent was a unit within itself, no cross bracing to adjacent

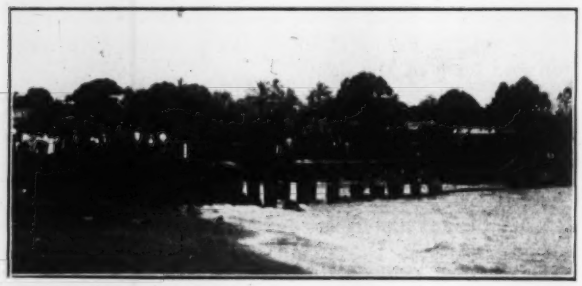


FIG. 1—CONDITION OF BRIDGE JUST AFTER COLLAPSE

bents having been provided. The total length of the bridge is 352 ft.

The type of construction is well illustrated in Fig. 2. On each cap was bolted a 12x12-in. timber. Resting on these were six 6x12-in. deck stringers, three under each side of the track.

The posts were constructed by sinking wooden forms to bedrock, excavating the interior, placing steel dowels in the solid rock and then filling the casing with reinforced concrete. At the time of construction there were from 8 to 10 ft. of sand above the solid rock on which the posts rest. This sand was expected to act in place of cross bracing.

From an examination after the failure it was found that most of this sand had washed away; under the section of the trestle which failed there remained only from 2 to 4 ft.

The first bent to fall was on the Wainaku side of the river which is opposite the piledriver shown in Fig. 2. This pier no doubt had been undermined. When it gave way it fell toward the center of the stream striking the adjacent pier and knocking it over. This continued until in all ten piers were overturned before a bent was reached which was sufficiently embedded in the sand to withstand the force of the blow from the adjacent falling bent.

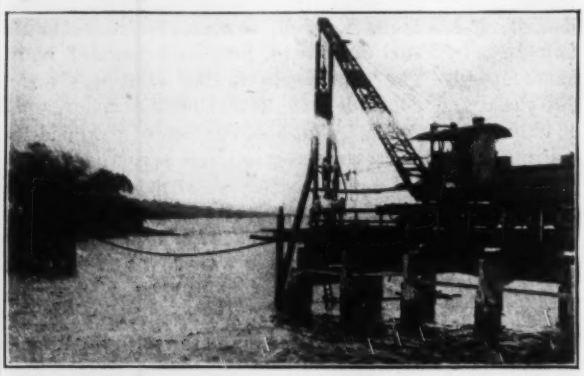


FIG. 2—DRIVING PILES FOR THE TEMPORARY BRIDGE
One of the overturned bents is resting against the bent under the leads of the driver.. The bracing between the caps was put in after the failure.

The failure emphasized two precautions that might have been taken when the original construction was done. Bracing from bent to bent should have been provided and the posts should have been set into the bedrock instead of on top of it.

It is thought that the recent tidal wave which visited Hawaii a short time before the failure had a great deal to do with washing out the sand from the bed of the river.

High Yield From Small Watershed With Large Water Area

By Frederic I. Winslow
Consulting Engineer, Framingham, Mass.

A CONSIDERABLY larger yield than appears to be normal from watersheds in Eastern Massachusetts is found at Framingham, in Farm Pond, which is an adjunct (now practically discarded) of the Metropolitan water-works for Boston and adjacent cities. This unusual yield may be due to underground flow from a slightly higher watershed, as explained further on.

TABLE I—HIGH YIELD FROM FARM POND WATERSHED*
Per Cent of Rainfall Appearing as Yield

Year	From Farm Pond: Published Figures	From Farm Pond: After Correction†	From Entire Sudbury Watershed
1916	95.9	85.0	47.6
1917	108.2	99.1	38.0
1918	98.5	88.2	38.2
1919	69.4	62.1	45.5
1920	83.8	74.7	53.6
1921	76.3	67.3	39.8
1922	66.7	57.6	45.1

* Area of watershed, including water surface, 0.54 sq.mi.; water surface, 0.25 sq.mi.; Storage capacity, 216 m.g. † Correction made for amount drawn from Pond.

Table I compares the Farm Pond yield for the last seven years, expressed in percentages of rainfall, with that of the entire Sudbury watershed, (including Farm Pond). For the last forty-eight years the average yield of the Sudbury has been 46 per cent of the rainfall, compared with which the Farm Pond yield for the past seven years has been from 25 to 115 per cent higher.

TABLE II—YIELD IN SECOND-FEET PER SQUARE MILE OF FARM POND, SUDBURY, WACHUSETT AND COCHITUATE WATERSHEDS

Year	From Farm Pond Using Annual Reports	From Farm Pond Corrected as in Table I	Entire Sudbury Watershed	Wachusett Watershed	Cochituate Watershed	Rainfall by Gage on Sudbury Watershed
1916	2.775	2.459	1.398	1.880	1.588	2.894
1917	3.253	2.902	1.161	1.290	1.216	3.005
1918	2.886	2.583	1.139	1.395	1.173	2.930
1919	2.341	2.094	1.529	1.945	1.634	3.372
1920	3.105	2.769	1.917	2.521	2.171	3.708
1921	2.474	2.183	1.276	1.690	1.518	3.244
1922*	2.211	1.908	1.516	2.045	1.701	3.312

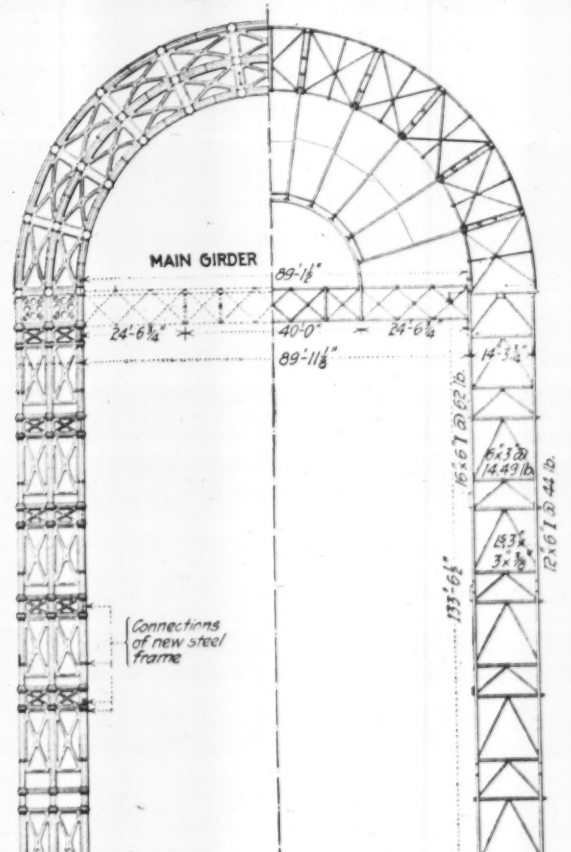
* The figures for 1922 are subject to possible slight correction after being issued in final form.

Table II compares the yield of Farm Pond in second-feet per square mile with that of the Sudbury, Wachusett and Cochituate watersheds.

Observations on the southerly side of Farm Pond show very little water when excavations are made; but on the north side, about 1,650 ft. away, is a pond—Larned's Pond—covering about 42 acres of possibly 100-m.g. capacity. This pond is about 7.85 ft. above Farm Pond, and has no visible outlet; but as the soil between the two ponds is largely gravel it may be that enough water passes through to account for the high yield on a different watershed from the last pond.

Old Cast-Iron Frame of Crystal Palace Strengthened by Steel Framing

AFTER seventy years, the well-known Crystal Palace in London was recently repaired in interesting manner. The building is a high, arch-roof structure with cast-iron framing, covering nearly 11 acres of ground surface, and has its entire exterior glazed. It is 384 ft. wide in its main portion and 1,392 ft. long with a clear height above ground of about 192 ft.; the height of the frame above footings is about 195 ft. It was built in 1851 and was expected to last only about 25 years, but is still in excellent condition. The repairs concerned chiefly the east face of the central aisle, which



FRAMING OF EAST FACE OF CRYSTAL PALACE

projects about 25 ft. from the main portion of the building, and they appear chargeable in the main to a weakness in the original construction, consisting of the use of timber plates between the cast-iron segments of the arch.

In the sketch herewith the cast-iron frame of the east face is shown at the left. Each of the two towers consists of three cast-iron posts, which are connected by horizontal girders and diagonal members, also of cast iron. On these towers is seated the arch, whose three ribs continue the lines of the posts of the towers. In the arch, however, radial members connected to a small central half ring (not shown) are inserted, and these radials are 5 x 10-in. timbers which pass between the contact faces of the successive segments and are subject to full arch pressure. Cast fascia members cover the outside of these members. The material of the radials is untreated soft wood, and decay has been extensive in the course of years, especially near the bolt holes. The result was serious settlement and distortion of the frame, many members being as much as 3 to 7 in. out of true. The method of repair was to erect an independent steel structure back of the cast-iron frame, and bolt all members of the cast-iron frame to the steel frame. The steel frame is shown at the right; its connections to the old frame are partly by direct bolting and partly by brackets carrying steel girders bolted to the cast-iron columns. The main verticals of the steel frame are I-beams, the outer one being 12 x 6 in. and the inner one 16 x 6 in.; they are connected by struts of 6 x 3-in. channels and diagonals of 3 x 3 x ⅜-in. angles. The old frame being not vertical and out of true, the connections between it and the new frame had to be such as to suit the varying horizontal distance between them, for which reason bracket connections were largely used. The work was planned by W. Wright, engineer for the Crystal Palace.

Concrete Road Maintenance Costs in Ohio, 1917-1922

BY E. C. BLOSSER
State Highway Engineer, Columbus, Ohio

OCCURRENCES recently demanded that we make a determination of the relative maintenance costs of plain and reinforced concrete pavements in Ohio, and a careful analysis was made from the maintenance records for the years 1917 to 1922 inclusive. The results are given in the accompanying table.

The widths and depths of the pavements are variable in both cases, the depths ranging from 6 to 9 in. and the costs are for surface only. The reinforced-concrete pavements include those with only circumferential reinforcement and light mesh reinforcement. The average cost of the reinforcement probably did not exceed $0.12 per square yard.

Using the average costs per square yard, the maintenance cost per mile per year for a plain concrete road 16 ft. wide is $209.33 and for a reinforced-concrete road 16 ft. wide is $40.36. The difference is $168.97, which capitalized at 5½ per cent equals $3,072. Considering maintenance costs alone, we are in general justified in expanding this amount for reinforcement. The advantage as to life of pavement probably favors reinforced concrete over plain concrete in the ratio of at least 5 to 4, i.e., if the average life of plain concrete is 20 years, for reinforced concrete it will be at least 25 years.

MAINTENANCE COSTS OF PLAIN AND REINFORCED-CONCRETE PAVEMENTS

Year	Sq.Yd. Completed	Accumulated Yardage	Total Maintenance Cost	Maintenance Cost per Sq.Yd.
1917	2,556,005*	2,556,005	$23,317	$0.00990
1918	175,303	2,731,308	29,477	0.01079
1919	321,299	3,052,607	34,892	0.01143
1920	677,758	3,730,365	85,214	0.02284
1921	516,091	4,246,456	145,690	0.03431
1922	520,910	4,767,366	106,986	0.02244
Average				$0.0223
		Reinforced Concrete		
1917	628,067*	628,067	$1,208	0.00192
1918	103,686	731,753	1,793	0.00245
1919	379,817	1,111,570	2,785	0.00250
1920	563,252	1,674,822	7,960	0.00475
1921	315,507	1,990,329	10,610	0.00533
1922	930,673	2,921,002	14,209	0.00487
Average				$0.0043

* These figures include all pavement built prior to 1918.

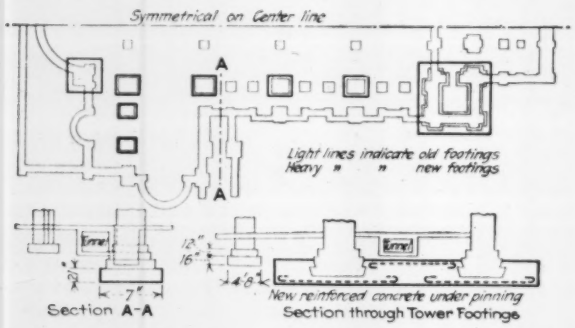
Underpinning a Church Foundation With Slab Footings

Soil Loading Reduced From 5 to 3½ Tons Per Square Foot by Spread Footings—Temporary Support by Pretest Piles

By Lazarus White
Spencer, White & Prentis, Engineers and Contractors, New York

IN ORDER to reduce the soil loading which would be imposed by the completed structure, a church in course of construction in Brooklyn has just been underpinned with spread footings of increased area. The operation was carried out by undermining the old footings, supporting the structure on "pretest piles" and temporary supports, and constructing the new reinforced-concrete footing slabs in the excavation. The work was rendered difficult and delicate by the fact that services in the church continued throughout the work.

Existing Conditions — The foundations and superstructure to the level of the main floor of the Church



ORIGINAL AND UNDERPINNED FOUNDATIONS OF CHURCH

of Our Lady of Perpetual Help were originally built in 1907 and 1908; a temporary roof was installed and services were conducted in the roomy basement. The structure is spacious, its extreme length being about 250 ft. and its breadth at the altar about 180 ft.

The original foundations were of the spread-footing type, and had been designed for an ultimate load of about 5 tons per square foot on the soil. When building operations were about to be resumed in 1922, the Bureau of Buildings of the borough of Brooklyn, after a reconsideration of the building plans and designs, ruled that the former allowable loading was too high and reduced the loading to 3½ tons per square foot. This placed a very serious problem before the architect, particularly at the tower foundations, whose estimated loads were over 3,000 tons for each tower. It was necessary almost to double the bearing area of each foundation.

The architect, F. Joseph Untersee, of Boston, with J. R. Worcester as consulting engineer, solved the problem of design by providing new and larger reinforced-concrete footings below the old footings, the reinforcement being so placed as to allow the placing of the large tower foundations in sections. To carry out this design it was necessary to underpin the old structure and transfer its load to the new footings. The construction was undertaken by Spencer, White & Prentis, Inc., of New York.

Underpinning Operations—Beginning with the tower foundations, the contractor took up the old floor and excavated to the bottom of the footings at one side of the church entrance, leaving the entrance clear. Excavation was then carried forward under the old foundations, the corners being first undermined and diagonal reinforced-concrete blocks placed under them for preliminary support. Then the entire area beneath the old footings was excavated, by tunneling methods, and pretest cylinders were driven in the soil below as temporary supports for the tower foundation. These cylinders were 14-in. steel pipes filled with concrete, each loaded by a hydraulic jack to 60 tons and then wedged up against the old footing by short lengths of I-beam set vertically on the cylinder as a strut, with steel wedges driven between the I-beams and the bottom of the footing.

With the tower foundation so prepared, a block of reinforced concrete 34 ft. square and 3 ft. thick was poured under the old footing. This operation was difficult chiefly because it had to be carried out in a very cramped space, and necessarily in one run to secure full benefit of the reinforcing. It was carried out in about 12 hr. time for each tower, with the use of an electrically driven mixer set up in the tower. Material was conveyed to the mixer from the sidewalk by wheelbarrows. The new concrete was carried up to within a few inches of the bottom of the old footing, and no attempt was made to obtain a tight contact in the first operation. A liberal number of 3-in. grout pipes were placed around the perimeter of the old footing, some of them being driven from the adjoining yard. Around the inside of the old footing, a sand dam a few inches high was built on the top of the new concrete, to hold the grout and permit its flow and spread from the grout pipes to be checked up. The grout was mixed in a large mortar box and run directly through the pipe. By this method perfect contact was secured between the old and the new concrete.

The small interior footings, each about 10 x 10 ft., were placed by similar methods, the work being carried on from an adjoining pipe tunnel under the church floor. Each of the old footings was supported on four pretest piles, the new concrete footing was then placed, and the contact grouted through holes drilled in the floor. Very little disturbance of the church floor was required in the entire work.

The contract was carried out in a few weeks, with little interference with the services in the church, and was wholly successful in its structural results. The success of the work was due, in the writer's opinion, largely to the skill of the men engaged upon it and to the combination of tunneling and underpinning methods in the operation.

New York State Aid to Health Laboratories

State aid to enable city and county health laboratories to provide laboratory service for local medical practitioners and for health officers is authorized by an act of the New York legislature of 1923 which carries an appropriation of $25,000 for the expenses of the State Department of Health to put the act in effect. The department may grant $2,500 towards the initial cost of installing and equipping such laboratories and may pay one-half the maintenance cost but not to exceed $7,500 a year for any one laboratory.

Building a 50-Kilometer Railroad Through Tropical Swamps

Log Cribs Substituted for Dirt Fills—Rude Barge Transports Materials—Pony Bents on Falsework Support Steel Span

By Francis R. Molther
Former Office Engineer, D. E. Wright Construction and Engineering Co., Inc., Panama

THE ECONOMIC desirability of putting a 50-km. stretch of railway in Honduras, C. A., into operating condition at the earliest date possible urged the employment of certain unusual devices to expedite construction. The use of these devices, while not generally commendable from the point of view of engineering practice, was justified by the existing conditions which made the expense of the construction a secondary consideration, and is explained here with that understanding.

The urgency of this work was complicated by the fact that the weather was most unseasonable for such extraordinary effort, heavy and continuous rains causing floods over much of the low territory in which the line was located. It was determined, therefore, to form log cribs or grillages, through the shallow fills from three to ten feet in height, for the purpose of carrying the ties and rails until the dry season might make the manipulation of the adjacent material more convenient. It was planned to make much of the actual fill by train, thus reducing the cost of handling the earth over cost of placing it by hand, beside making execution possible under less urgent conditions. The absorption of the logs due to decomposition obviously indicated that bringing the line to grade with earth would be a question of several years.

The first course was laid so as to provide longitudinal members, parallel to the rails, in the top course of the crib, alternating longitudinal and transverse systems between them. The material was hauled into place with oxen, owing to the great capacity of these animals for work in soft ground. The ties were shimmed to grade as much as possible, but the use of thin shims was generally avoided. In dry weather this flooded territory bakes as dry and hard as pottery, making the timber fills look strangely out of place.

The route of this line crossed a river with a 200-ft. through-riveted span about three kilometers from a switch to the main line. This stream cut off the laying of track during the time required for the erection of a temporary trestle, although grading was complete for some distance on the far side of the stream.

For the purpose of laying steel on the distant graded section, which not only assured the use of that portion as soon as the trestle might be completed, but also furthered the progress of more remote grading, a barge or ferry was rigged up to convey ties, rails and accessories to the other side.

The barge was swung from two pulleys traveling on a steel cable spliced around stout trees on the opposite banks. The lines to the pulleys were adjusted at different lengths, so that the upstream side of the barge was presented to the current at an angle that furnished some assistance from the flow in crossing with the barge loaded. A manila rope swung from the same trees, and connected to the barge with a hand-line running on the rope by means of an eye, furnished the means to haul the barge back when unloaded.

One or two fills between 500 and 1,000 ft. long which delayed the laying of rail on completed grading beyond them required the use of a detour to get material to the completed dump ahead.

As soon as steel was laid to the end of the completed grade, 20-lb. rail was laid from this point down into the gully where grading was incomplete, but outside the toe of the proposed fill. This light rail was continued up to the completed work ahead, where ties, rail and accessories were received from hand cars loaded alongside the regular flat-cars that were run to the end of rail and the beginning of the detour. Oxen and men hauled the hand cars over the light rail.

In the figure are shown pony bents built on top of regular falsework for a through-riveted steel truss bridge, to facilitate the removal of the falsework after the truss was erected. The falsework was of four-pile double-braced construction cut off to place the main

DETAIL OF PONY BENTS

caps 5 ft. under the bottom chord of the bridge. Through pile pony bents were built of 12 x 12-in. material, also double braced, to 6 in. below the level of the bottom chord, which proved sufficiently sturdy to carry the steel.

State Bureau of Housing and Regional Planning for New York

A STATE Bureau of Housing and Regional Planning within the Department of Architecture was created by the legislature of 1923 and $10,000 appropriated for its expenses. The bureau will be in charge of a commission of eight members, consisting of the state architect, the state highway commissioner (now a bureau head in the Department of Public Works) and the state industrial commissioner, ex-officio, and five "lay members" appointed by the state architect. All the members serve without salary but are to receive traveling expenses. Besides being required to make a special report on the present housing shortage and a yearly general report the duties of the new bureau are:

1. Study housing needs and conditions in the State and prepare plans adapted to meet such needs and conditions.
2. Collect and distribute information relating to housing and community planning and study means of lowering rents on dwellings by securing economy in the construction and the arrangement of the buildings.
3. Assist in the preparation of legislation and regulations in relation to housing, zoning and planning throughout the State.
4. Co-operate with local housing boards or similar bodies in cities and localities and with State and Federal authorities.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Small Motor-Driven Foundation Hoists

INDIVIDUAL electric hoists with 2-hp. motors are being used in sinking the 160 foundation wells for the Illinois Merchants' Bank Building, Chicago, instead of the more usual arrangement of having the hoists for a row of wells operated by an endless running rope driven by an engine or motor. This new arrangement is shown in the accompanying view. At each well there is the usual tripod carrying a sheave over the well and having a canvas cover for weather protection. Ordinarily, a short shaft mounted on one post of the tripod carries a niggerhead or drum at the inner or well side and has at the outer end a grooved sheave around which the driving cable is looped.

SHAFT HOIST WITH 2-HP. MOTOR

With the new equipment, the drum, shaft, motor and transmission or reducing gear form a self-contained unit mounted in tandem on a bed plate, one end of which is supported by a steel leg while the other end rests on a timber placed across two posts of the tripod. In the view the well is partly covered with planks. From the drum the rope passes up over the head sheave and down to the bucket. The drum runs continually and the rope makes two or three turns around it, the hoist man drawing the rope tightly upon it to get the friction necessary for hoisting, or letting the rope run loose for the bucket to overhaul in lowering.

Flexibility and convenience of operation are among the advantages claimed for the individual motor-driven hoist system. Each well is independent of the others and as soon as it is completed the hoist can be shifted to another site. But with the cable system the rig for a set of wells must remain in place until the last one is completed, although it may be operating only one or two of the wells; and time is also consumed in making the set-up for another row of wells. Furthermore, the individual hoists avoid the trouble of long running cables across the site and are both convenient and economical where wells cannot be operated in rows but must be handled singly.

These new electric hoists, which have been used also in trench excavation, are built by Louis Falzer & Co., Chicago. At the Illinois Merchants' Bank Building, eighteen hoists are in use for sinking the 160 wells by the Henry Ericsson Co., Chicago, contractors for the building.

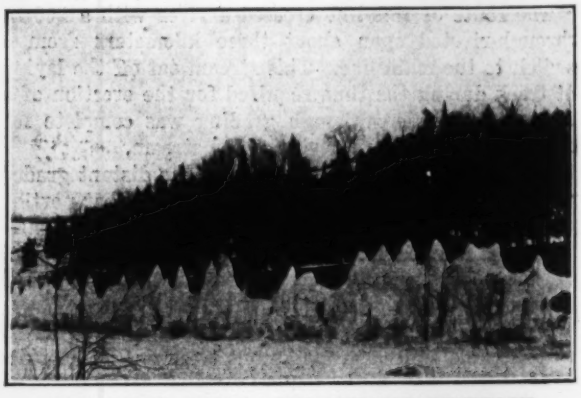
Ice as a Protection Against Ice in Exposed Penstocks

BY J. LEROY UNDERHILL
Inspector, Vermont Department of Highways

AFTER several winters in which the half mile of 6-ft. penstock at power house No. 4 of the Montpelier & Barre Light & Power Co. had been a continued source of trouble and expense due to ice forming on the inside, Mr. Lawrence, the chief engineer of the company, resorted to an unusual method of protecting the penstock against further frost action. On the first 1,500 ft. below the dam he had ½-in. holes drilled in the top of the penstock at 12 ft. centers. For the remainder of the distance the same spacing was used, but due to increased head, the diameter of the holes was reduced to ⅜ in.

The accompanying photograph shows the results that were obtained, and after having been used for four winters, the method is endorsed by Mr. Lawrence as being a very satisfactory means of preventing interior ice formation. It is usually necessary to keep the ice chopped down until sufficient water has escaped to form the required thickness of covering after which the jets may be allowed to flow until frozen.

Contrary to belief, it is not necessary to plug the holes in the Spring. Owing to their small diameter, they are effectively closed by the large amount of suspended matter carried in the water at that period of the year. They can be easily cleared with a sharp-pointed tool when it is desired to prepare the penstock for Winter again.



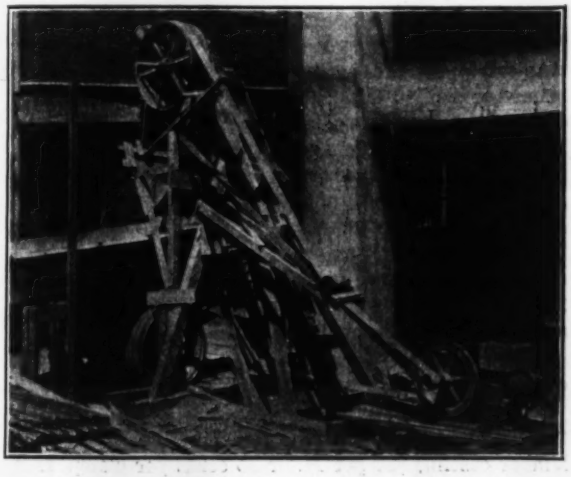
ICE JACKET AROUND THE EXPOSED PENSTOCK

Bucket Elevator Useful in Excavating Basement

THE CONSTRUCTION program on an office building in Fresno, Calif., being built for the San Joaquin Light & Power Corp., was such that it was necessary to remove several hundred cubic yards of earth after the foundation walls and part of the superstructure had been built. An old bucket elevator of suitable size was available and the contractor set this up in one corner of the basement and operated it at low cost with a 4-hp. gasoline engine.

The elevator was set so that with its lower end below the basement floor level its upper end would deliver through a short chute directly into trucks standing in an alley. A belt drive was used between engine and elevator and the use of a 30-in. pulley at the upper or elevator end of the belt gave the desired speed. Alongside the driving pulley was an idler pulley onto which the belt could be slipped by pushing a lever. Thus the gasoline engine was allowed to run continuously but by shifting to and from the idler pulley the bucket elevator proper was operated only when a truck was in position to receive the material. This did away with the necessity of bunkers. The shaft driven by the belt carried a smooth-face double-flanged wheel over which the links of the bucket elevator passed, the friction being sufficient to drive the elevator without the use of sprocket teeth.

No bin or other receptacle was provided at the lower end of the elevator, the material being merely piled up by shoveling or dumping from wheelbarrows. A shovel man was kept in attendance at the lower end when the elevator was working to shovel spillage from the buckets back onto the feed pile. As many as 12 men were required in the basement to keep the elevator busy when the material had to be moved by wheelbarrows the maximum distance of 60 to 75 ft.



BUCKET ELEVATOR FOR LOADING FROM BASEMENT

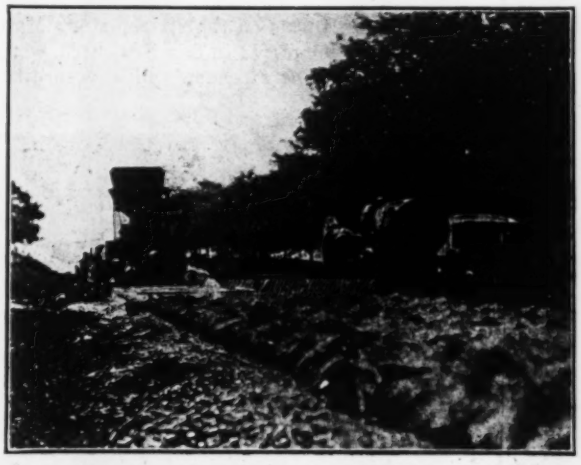
One man was required at the top to start and stop the elevator and generally superintend its operation and the loading of trucks. Trucks handling 5 cu.yd. were loaded in about twelve minutes.

The contract is being carried out by the R. F. Felchin Co. of Fresno for whom E. M. Lewis is superintendent of construction.

Street Sprinkler Used in Curing Concrete Pavement

BY J. G. BRAGG
Senior Testing Engineer, New Jersey Highway Department, Trenton, N. J.

THE New Jersey state highway specifications require that concrete pavements be covered with salt hay or straw as soon as possible after placing the concrete, and this covering kept damp for a period of at least ten days. The usual procedure is to take the water from a pipe line supplying the mixer, hose connections having been provided at frequent intervals for that purpose. In cases where the road is constructed full width in one operation, from one-half to one mile of road is being cured at all times. If the covering is kept sufficiently moist, this is by no means a small undertaking, but it becomes still more difficult when the pavement is constructed one-half width because of the greater length to be cured.



SPRINKLER WITH SPECIALLY MADE DISTRIBUTOR

The accompanying photograph shows portions of half-width construction being efficiently sprinkled with a horse-drawn street sprinkler, equipped with a special distributor consisting of a length of galvanized leader pipe in which holes have been bored about 5 in. apart. The distributor is hung on a pivot so that it may be swung to either side of the sprinkler.

The road under construction is known as Section 8 of State Highway Route 9, between Somerville and North Branch, N. J., and was built by Ralph Sangiovanni, of Newark, N. J.

Excavation Costs by Draglines

AVERAGE unit costs of comparable dragline excavation of drains for the 1922 season on some of the U. S. Reclamation Service projects are given in the following table. Costs are for machine operation only with no overhead:

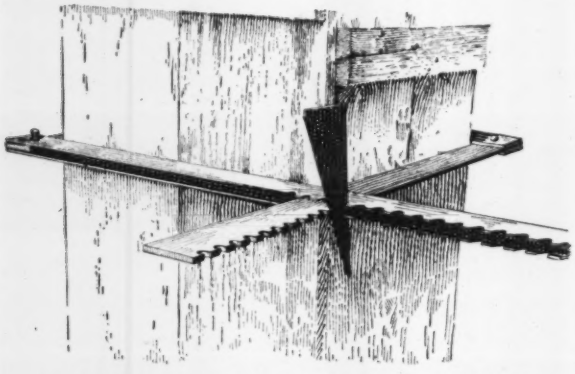
Project	Cu.Yd.	Unit Cost	Dragline Machines Used
Shoshone	836,800	$0.110	3 Bucyrus 9½ elec.; 1 Bucyrus 9½ gas; 1 Bucyrus 14 gas; 2 Pawling & Harnischfeger 206 gas.
No. Platte	522,085	.121	2 Monighan 1T gas; 1 Bucyrus 9½ elec.; 1 Bucyrus 14 gas; 1 Pawling & Harnischfeger 206 gas.
Newlands	1,706,816	.091	2 Bucyrus 14 gas; 1 Pawling & Harnischfeger 208 gas; 1 Austin 4 gas; 3 Monighan 1 T gas.
Rio Grande	1,770,605	.072	5 Bucyrus 9½ gas; 1 Monighan 2T gas; 3 Pawling & Harnischfeger 206 gas; 1 Bucyrus 30B gas.

In the table below is shown the average cost of canal excavation by draglines this season. As for the drains these costs are for machine operation only. Drilling and blasting and engineering and overhead are not included in costs.

Project	Cu.Yd.	Unit Cost	Dragline Machines Used
Klamath	442,737	$0.120	1 Monighar 1T gas; 1 Bucyrus 30 gas; 1 Bucyrus 14 gas; 1 Pawling & Harnischfeger 206 gas.
N. Platte	1,149,782	.107	1 Monighan 1T gas; 1 Bucyrus 14 gas; 2 Bucyrus 9½ elec.

Metal Clamp for Concrete Column Forms Saves Cost and Time

CONCRETE column forms on the sixteen-story Matson Building, just completed in San Francisco, were held in place by a new type of clamp which, according



CLOSE VIEW OF CLAMP IN POSITION ON FORM

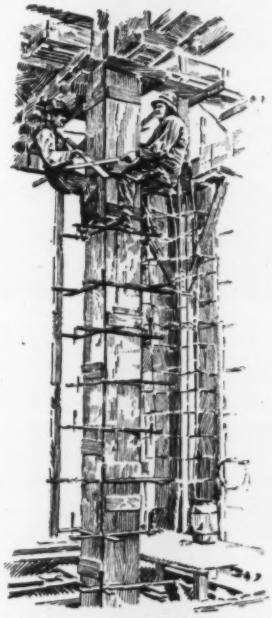
to the Lindgren Co., general contractors, saved $1,500 on this job over the cost of accomplishing the same purpose with the ordinary wooden clamps. A further economy resulted from being able to fill the column forms to the top in one continuous operation as fast as the concrete could be dumped from the buggies. The surrounding slab was poured as soon as the column form was full, the runway for the buggies being moved back as the pour advanced and each succeeding column being filled as it was reached. This reduced the number of runways required to make the pour and also the labor of shifting them around. Since its success on this job the device has been patented as the "Wedge Notch Form Clamp."

As used on the Matson Building the clamps consisted of two pairs of intersecting arms, 3 ft. long, and two wedges. Each pair of arms consisted of one double bar (two 2½x⅞-in. pieces) and one single bar (one 2½x⅞-in. piece). The single bar was held between the double bars by a ½-in. loose rivet which was secured with a cotter pin. The double bar was held together at the other end and at the center by countersunk rivets with ⅜-in. washers as spacers between the bars.

The ends of the bars were notched, the notches being on the outside of the arms and set at an angle of 45 deg. with the longitudinal axis. The wedges were 8 in. long, ¼ in. thick and tapered from a 2-in. width at the top to a ¼-in. bottom width. The complete clamp weighed 37 lb. or about the same as the wooden clamp which it replaced. In the size used on this building the clamps were adjustable to any rectangular column from 6 in. to 30 in. square. This range was made possible by a hole in each arm half way from hinge to notch into which the loose rivet hinge could be transferred when clamping smaller sized forms. The loose rivet was used in place of a bolt to avoid delay in making shifts that might otherwise be due to rust or concrete in the bolt threads.

The column forms were made on a bench, placed in the usual way and held temporarily by nailing the edges of the panels together at bottom, center and top. The first steel clamp was then placed 9 in. above the floor and each succeeding clamp 18 in. above the one last placed. In setting the clamps the single bar in each pair of arms was slid through the double bar in the opposing pair until all four arms rested against the form. The wedges were then inserted so as to engage opposed notches and driven home with a hammer. It was found that the wedges exerted sufficient pressure to draw the form boards tightly together and prevent any leakage of water and cement.

As the forms were set higher up the column the men soon found that they could climb up on the clamps, hooking one knee over the projecting arm of the top clamp and resting the other foot on the next clamp below. In this way, and taking the average for the job, the seven clamps on a column were placed by two men in twelve minutes and one man stripped the seven clamps and piled them at the base of the column in four minutes. These figures, which give an average for clamping and stripping of one man's time for four minutes on each clamp, were used in estimating the comparative saving of the metal clamps over wooden clamps. The cost of using wooden clamps was estimated on the basis of lumber costing $35 per M. or 35 cents per clamp, framing 40 cents and removal 5 cents, or a total of 80 cents per wooden clamp.



WORKMEN CLIMB ON THE CLAMPS AS THEY ARE PLACED

The first story columns on the street fronts of this building are T-shaped. To use the steel clamps on these columns 2-in. filler blocks were cut to fit between the stem of the T and the clamps.

From Job and Office

Hints that Cut Cost and Time

Prize for Street-Railway Crossing Design

One of the members of the Contractors' Association of Philadelphia has offered a $50 prize for an expression of the best idea or experience in connection with paving a street intersection containing a railway crossing. The contest is open to anyone connected with public construction work.

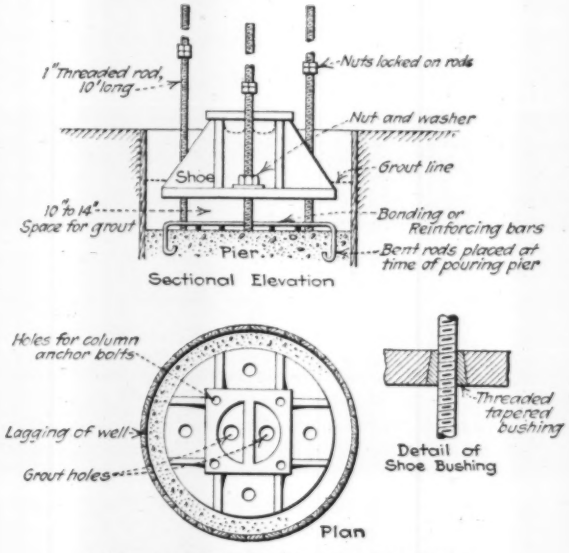
From Job and Office

For Contractor and Engineer

New Method of Placing Column Shoes for Steel Frame Buildings

A CONVENIENT method of setting column shoes and grillage on the foundation piers of large buildings is being employed in the construction of the new Union Station at Chicago. It permits of more rapid erection and insures stable support for shoe and column.

In common practice, after the head of the pier has been cleaned of laitance and foreign material, the shoe is placed on brick or concrete blocking on top of the



SCREW SUPPORTS FOR COLUMN SHOES

pier and, after it is adjusted to level, grout is poured in through holes in the base to fill the 3- to 6-in. space between the shoe and the pier. This grout is usually required to be left for 70 to 90 hours before any load is placed on the shoe. When a girder is to be fitted against the web of the column, it is customary for the erector to push the column laterally so that the girder will clear the flanges. This movement of the column frequently results in a tipping of the shoe and crushing of the grout under its edges, especially as the grouting is often more or less incomplete or defective. Tilting of the shoe in this way may result in considerable expense and delay by making it necessary to remove the column, readjust the shoe and then start the steelwork again.

The new method of carrying the shoe consists of providing an adjustable support which will hold the shoe in place until the grouting has been completed, and which will take care of erection stresses until the grout has hardened sufficiently to take the required stress. Four taper holes are cored in the shoe base, and threaded taper bushings of soft steel are set in them, as shown by the sketch. Four 1-in. steel rods 10 ft. long, threaded for their entire length, are used for raising or lowering the shoe.

When the shoe is to be placed, the four rods are screwed into the threaded bushings, so as to project 12 or 14 in. below the base. A nut and washer on top of the base are screwed up when the shoe has been adjusted so as to prevent the shoe from tipping. Two square nuts are locked on the upper part of each rod, above the shoe. The shoe is brought to exact level by gripping each threaded bar with a wrench applied to the locked nuts, thus turning the bars like screw jacks until the shoe is raised or lowered to proper level. Wedges driven between the shoe and the wood lagging of the pier prevent lateral displacement of the shoe. Then 1:1 grout is pumped in to fill the space under the shoe. To bond this grout cap to the pier, two hook-end bars have their vertical ends set in the concrete at the time the pier is being completed.

When the grouting is completed, the projecting ends of the threaded rods are broken off above the nuts and washers with a cold chisel, and are used in another shoe.

The usual cost of setting one shoe by the old method ranges between $50 and $300, and sometimes reaches $400 with a large shoe or grillage lowered to a considerable depth in the casing or well above the top of the pier. With the rod method, the labor cost of setting a shoe averages about $12, and the total cost $22.

This new method of securing column shoes to concrete piers for support of steel structural work was invented by G. W. Allen, superintendent of construction for Graham, Anderson, Probst & White, of Chicago, who are the architects for the Union Station.

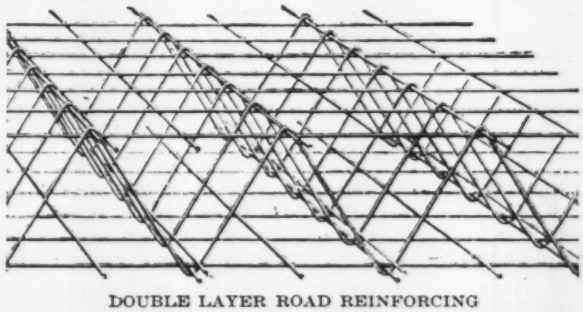
Double Layer Reinforcement for Roads

By R. Johnstone-Taylor
Shrewsbury, England

WITH the idea of developing the most effective type of reinforcement for reinforced-concrete roads a number of British engineers have devised a system of double layer reinforcing, the theories upon which it is used being explained below.

The nature of the effective loading is always indefinite and there cannot be exact knowledge regarding the action of the ground in supporting the slab. The advantage generally assigned to a double layer fabric is that it will take up tensile stress occurring along the upper part of the slab under certain conditions and will also provide for shear stress due to heavily-loaded axles supporting machines traveling at high speed.

The type of double layer reinforcement used consists of a bottom layer, a top layer, and a connecting fabric. The first and second consist of hard drawn steel mesh, the transverse members being electrically welded to the longitudinal members. The assembly on the site



DOUBLE LAYER ROAD REINFORCING

is perfectly simple and the method of doing the work is evident from the illustration.

Simulating Summer Conditions for Mid-Winter Construction

TO CARRY ON a large building operation in the midst of Adirondack winter conditions without the loss of a single day's work due to the cold, or storm, was the unique record made at Lake Placid last winter. The operation included the construction of the first three units of the new Lake Placid club house, a reinforced-concrete structure, faced with a local rubble stone up to the second story level and with rough texture chocolate-brown brick above. The three units are: Unit A, 44 x 105 ft., five and six stories and basement; Unit B, 35 x 38 ft., four stories and basement; and Unit C, 17 x 32 ft., five stories and basement. The frame is of reinforced concrete in bays 18 x 21 ft. with a 6-ft. corridor between them, running lengthwise of buildings A and B. The floors are structural slabs, 2 in. thick, reinforced with mesh for temperature stresses only, carried on reinforced-concrete ribs 25 in. on centers. Over this slab is placed 2 in. of cinder concrete with

FIG. 1—INTERIOR OF THE ENCLOSURE SHOWING THE METHOD OF FRAMING AND SUPPORTING FORMS

wooden sleepers on 12-in. centers laid flush with the surface. The maple floor is nailed direct to the sleepers without the use of underflooring. The corridors are floored with cork tile laid on cinder concrete with a troweled cement finish. Partitions, except at stair and elevator shafts, are of gypsum.

In order to carry out the work during the winter a wooden inclosure was built around the space to be occupied by the completed building and made larger than the building to allow for a working space of about 5 ft. between the finished walls of the new building and the sides of the inclosure. The roof of the inclosure was supported on wooden bents to the full height of the temporary structure. These bents were placed 10 ft. on centers and they were made up of 3 x 4 verticals, braced transversely and longitudinally.

The exterior walls were of 2 x 6 material, 30 in. on centers, sheeted on the outside with ¾-in. matched boards, and faced on the inside with tar paper.

Fig. 1 well illustrates the type of framing and the method of supporting the forms for concrete. All forms were of wood. The posts were built into the floor slabs and later cut off flush. 150,000 ft. b.m. of lumber were required for the inclosure.

After the inclosure was roofed over, it was heated by a B. F. Sturtevant Vento system, with a capacity of

From Job and Office

Hints that Cut Cost and Time

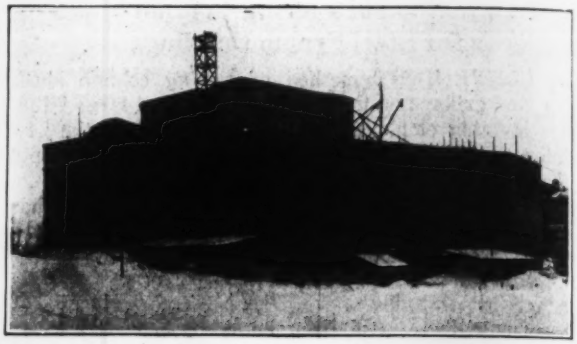


FIG. 2—THE ENCLOSURE IN MID-WINTER

15,000 cu.ft. per min. at a temperature of 150 degrees. Steam was supplied from the boilers serving the present buildings of the Lake Placid Club. The coal consumption averaged 3½ tons a day. The heated air was distributed throughout the inclosure in wooden ducts. Artificial lighting was necessary inside the building after the outside walls and interior partitions were up, only a few small windows having been placed in the sides of the inclosure.

Excavation for the foundations was begun on Nov. 23, 1922, by the owners of the property, the Lake Placid Club Co. Even at that early date the ground was frozen enough to require blasting. The footings were started on Nov. 29, and completed on Dec. 7. They were carried to a depth of 5½ ft. below the finished external grade. Their depth was dictated by frost penetration rather than by the class of material on which they were built. Measurements of the depth of frost penetration this spring showed 62 in.

The work on the foundation walls and the first floor was carried on before the inclosure was completed, all exposed work being protected by canvas covers and heated with coke salamanders. The inclosure was completed to the fifth floor level and roofed over on Jan. 11. The heat was then turned into it and thereafter the men could work inside without heavy coats and gloves, the temperature averaging above 55 degrees, except on some

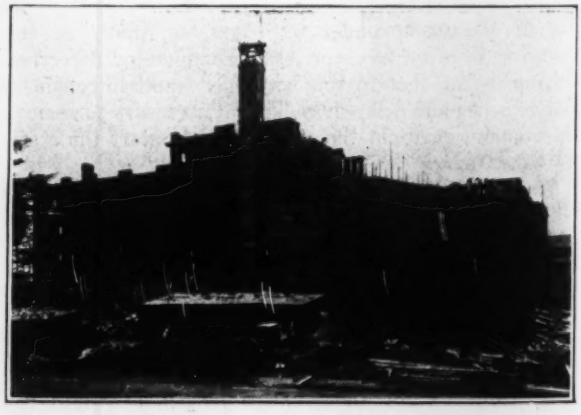


FIG. 3—REMOVING THE ENCLOSURE IN THE SPRING

From Job and Office

For Contractor and Engineer

extremely cold days. Only once did a thermometer register down to freezing inside the inclosure and then only along the ground below the level of the heating ducts. At the time the outside temperature was 32 degrees below zero. Specimen temperatures on days of low temperature were as follows: Outside, 36 below zero, inside 40 to 58 above; outside 24 below, inside 42 to 46 above.

As much of the building material as could be obtained in the early winter was brought to the site while the roads were good and was stored outside the inclosure, under canvas covers. Some of the reinforcing steel was later stored in one of the clear spaces within the inclosure. Materials for the concrete were heated with steam, since it was necessary to store these materials outside of the inclosure.

When the building was started a progress schedule was prepared, and except for the first and second floors, was followed so closely that the high roof was completed on the schedule date, March 1. The progress was as follows:

1st floor concreting completed A—Jan. 12; B—Jan. 18; C—Jan. 23.
2nd floor concreting completed A—Jan. 27; B—Jan. 28; C—Jan. 29.
3rd floor concreting completed A—Feb. 2; B—Feb. 3; C—Feb. 5.
4th floor concreting completed A—Feb. 8; B—Feb. 9; C—Feb. 10.
5th floor concreting completed A—Feb. 14; B—Feb. 15; C—Feb. 16.
6th floor concreting completed A—March 1.

The plastering was all done before the inclosure was removed, flood lighting being used to provide proper illumination. The building was substantially completed on May 15, and the inclosure was completely dismantled by April 28.

This work was done by the Turner Construction Co., New York. The architect was William G. Distin, Saranac Lake, N. Y. Information for this article was furnished by H. H. Alger.

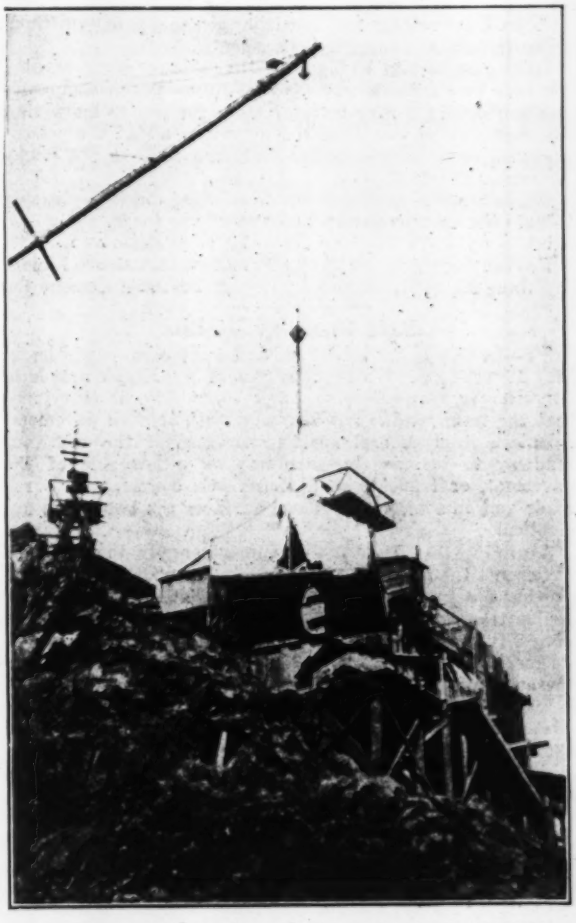
"Duckboards" Handy for Building Concrete Buggy Runways

WHERE concrete buggies have to be wheeled over runways or ramps supported on trestles, the R. F. Felchin Co. of Fresno builds up the runways quickly and at low cost by the use of sections called "duckboards." These are 4x14 ft. in size and consist of 1x6-in. boards cut in 4-ft. lengths and nailed as a flooring onto three 14-ft. 3x4's that serve as joists. One of the 3x4's is placed in the center section and the others are placed 1½ in. inside each edge of the 4-ft. flooring, thus the sections are light and easy to handle, and, since they can be quickly made from old form lumber, do not cost much.

The duckboards are used repeatedly and as they pile up in small space can be readily stored or taken from job to job. When supporting these sections on trestles they are held in place by short lengths of scantling nailed to the support and to the outer joists. When this is done the result is much stronger and safer construction than loose planks and can be put in place almost as quickly. Outer joists are not set more than 1½ in. from the ends of the board because a greater overhang is likely to be broken off under the wheels of the loaded buggies.

Cement Protected From Weather by Tent Placed With Derrick

IN RAISING the height of the Copco Dam, which is near the California-Oregon line, a canvas tent stretched over a light wooden framework was found to be a convenient and economical means of protecting cement from sudden rainstorms or from heavy dew during the night. Cement storage warehouses were permanently roofed over, of course, but the comparatively small quantity of cement kept piled on the platform alongside the concrete mixer could not be kept under a permanent roof without rehandling because delivery was made from directly above by means of a derrick.



LOWERING THE TENT TO THE CEMENT PLATFORM

Tent is lowered by derrick at the end of each night's run over cement remaining on the mixer platform.

The tent on its wooden frame was therefore built up and set at a convenient spot where the derrick boom could reach it, and at the close of the day's work or whenever operations were stopped on account of rainfall, this tent was picked up bodily by the derrick and lowered into place over the cement that remained on the platform at the mixer. The same tent was used through the two winter seasons over which the work was in progress.

The raising of the Copco Dam was done under the supervision of P. O. Crawford, chief engineer, California Oregon Power Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Selling Cement by Sack

Sir—I have observed with interest your reference, under the caption "A Rational Change," to the adoption of the sack unit for selling and invoicing cement, in *Engineering News-Record* of June 21, 1923.

In this connection I may state that this company adopted the sack unit quite a while before either of the companies mentioned, and it may be interesting for you to know that the sack unit is now observed by nearly all of the cement manufacturers in this section including mills in the Rocky Mountain district.

We believed it to be a desirable change, and it is pleasing to note the commendatory attitude of the trade.

L. T. SUNDERLAND,
President, Ash Grove Lime & Portland Cement Co.

Kansas City, Mo.,
June 28, 1923.

Safe Roadway Widths

Sir—In the letter by L. R. Ash on roadway widths in May 17 issue, p. 894, with reference to Mr. Kipp's article in *Engineering News-Record*, April 19, p. 699, it is evident that the term roadway is confused with that of pavement. I believe it is general practice to consider the width of roadway to include the shoulders on either side of the pavement, or traveled road metal. Of course, with earth roads and, in some cases, gravel surfaces the two terms are identical.

Assuming that Mr. Ash's comments apply to widths of pavements the question arises as to what width is logical to provide for two lines of traffic, or, in other words, for a double track road. The average truck body is not greater than 8 ft. wide and the maximum width over all of a passenger automobile is 5.5 ft. Of course there are trucks operating on our highways with bodies greater than 8 ft. in width, but widths are restricted by statute in most states now, and doubtless will be by all in time. The speed of trucks, especially those loaded to the legal limit, is also limited by state laws. To construct a pavement for the exceptional case of excessive truck body width or for truck speeds exceeding legal limits cannot be justified economically. With trucks, 8 ft. wide, passing on an 18-ft. pavement and with the outside wheels 18 in. from the edges, there is a clearance of 2 ft. between bodies. This clearance is too little for high speed operation or even for comfort, but it indicates that trucks can pass with the wheels remaining well on the pavement. However, the writer believes that the correct criterion for determining the proper width of pavement is obtained when a passenger automobile passes a truck. This case would apply to at least 90 per cent of the highway mileage. By this criterion center clearance on 18-ft. pavement is 3½ ft., which is believed to be ample for high speed traffic. The general practice on all modern road improvements is to widen the pavement on curves, which eliminates that complication. It is not believed that the additional cost of pavement width greater than 18 ft. for a double track road can be justified from an economical standpoint, and there is a practical objection to a width of 20 ft. This objection is based on the observation that a 20-ft. width invites a third line of traffic with the attendant risk of accident because of the small clearances provided. In other words there is danger in increasing the width beyond what is ample for the great preponderance of traffic and still does not encourage the passing of slow-moving by high-speed vehicles, forcing a third traffic lane for which the pavement was not designed.

For two lines of high-speed passenger automobile traffic and one line of slow-moving truck traffic an analysis similar to this indicates a required pavement width of 27 ft.

With reference to types of construction it is a well known fact that macadam with a bituminous top course breaks off in "scallops" at the edges, thus decreasing the effective width. On the other hand, in the case of rigid pavements the occurrence of dangerous ruts in the shoulder adjacent to the pavement is more frequent and pronounced than in the flexible type and the traffic will consequently not venture so near to the edges of the pavement, the practical effect of which is to decrease the effective width.

G. F. SCHLESINGER,
Consulting Engineer.

Columbus, Ohio,
May 29, 1923.

Interpretation of New York Timber Tests

Sir—Your brief analysis of the timber tests conducted under the auspices of the New York Lumber Trade Association, in the issue of June 21, contains one or two erroneous statements to which I would beg to call your attention. The purpose of these tests was not the comparative study of the two species of wood tested, but an attempt to secure some practical data upon which to base a proposed revision of the New York Building Code. It was the consensus of opinion of those engaged in the lumber industry in this section that the recommendations of the U. S. Forest Products Laboratory were at least not applicable to the character and quality of timber available in the New York market.

The test specimens of both Southern pine and Douglas fir were selected from commercial stocks of local yards, except that during the progress of the tests a shipment of 15 especially selected Douglas fir specimens was received from the West Coast via the Baltimore yards of the Weyerhaeuser company, of which 13 were tested and gave the excellent results noted. These specimens were not included in the original test program nor do they represent a grade available in this market either at the time of tests or at present. The results of the tests on the special timbers were not considered by the New York Lumber Trade Association.

The tests proved that the ordinary run of Southern longleaf yellow pine available in the New York market could safely be used at the working stresses in bending specified by the existing building code (of Mar. 30, 1915), but that the stresses for ordinary run Douglas fir as proposed for amendment of the code of Mar. 1, 1921, through the recommendation of the Board of Standards and Appeals were excessive. The tests also indicated the character and quality of defects that are commonly encountered in both species and gave valuable data as to their influence on the strength of structural size members. It was also clearly demonstrated that to equal the ordinary run Southern longleaf yellow pine, which consisted in large part of S_3 and S_4 specimens under the proposed rules of the U. S. Forest Products Laboratory, it would be necessary to specify the higher S_2 grade of Douglas fir.

The proposed standardization of grades of structural timbers, as contemplated by the recommendations of the U. S. Forest Products Laboratory, loses sight of the desired goal of this process, that is, economical manufacture and use. The rules recommended, besides being too complicated, exacting and unpractical in application, do not secure results that warrant the greater expenditure of time and waste of raw material required by them.

The National Lumber Manufacturers' Association has compiled the recommendations of the Southern Pine Association and the West Coast Forest Products Bureau governing standardized grades which have been presented to the timber committees of the several technical societies whose activities involve the study and use of structural timbers. These recommendations provide for three structural grades, standard, select structural and common, and are adaptable to practical methods of manufacture as developed by the lumberman after years of experience with his product.

GEORGE E. STREHAN,
Consulting Engineer,
Southern Pine Association.

New York, June 25.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Fire Caused by an Explosion destroyed the municipally-owned garbage-reduction works of New Bedford, Mass., on June 22.

A Net Income of $20,635,186 for the year 1922 is reported by the New York Central. This amounts to 7.20 per cent on the common stock as compared with 8.93 per cent in 1921, and a deficit in 1920.

The Bill Providing For the construction of branch lines to the Canadian National Railways during a period of three years at a cost of approximately $28,000,000, which was passed by the House of Commons, was rejected by the Senate on June 29, by a vote of 47 to 10.

Four Hundred Pullman Cars were used for the accommodation of the Shriners at Washington during the recent convention. To keep the storage batteries of these cars charged while they were standing still the Pennsylvania R.R. used 130 lighting plants with a capacity of 1½ kw. and supplying current at 32 volts, mounted on skids and distributed among the cars.

Appointment of "a Professional Engineer of broad experience" as a member of the Milwaukee Sewerage Commission, to fill a vacancy caused by resignation, has been urged upon the mayor by the Engineers Society of Milwaukee. It is pointed out that results previously achieved by the commission when an engineer was a member are recommendation for the appointment of another engineer to that body.

As Soon As the Detailed plans and specifications for the improvement of Montreal Harbor, at an estimated cost of $10,000,000, have been approved by the Dominion government the work will begin. The program includes the extension of the grain storage and handling capacity at Windmill Point and deepening of the basin there; reconstruction and heightening of wharves; construction of new wharves and railway connections for the grain elevator at Tarte pier now under construction; and extensions of piers in the central harbor.

The Harbor Car Service Bureau, organized for centralizing the handling, tracing and checking of railroad cars on the San Francisco waterfront, is now operating with offices at 110 Market street, San Francisco. It was formed by fourteen of the largest steamship and stevedoring companies. A complete record of movements of all steamer lines will be kept for the benefit of shippers and correct information on car loadings, toll, wharfage, switching, demurrage, etc., supplied. The bureau's services are free of charge to shippers and consignees. Anthony W. Frost is superintendent of the bureau.

President's Coal Commission Reports on the Anthracite Mines

Document Contains 30,000 Words—Strict Regulation Rather Than Government Ownership Recommended—Analysis of Cost

The preliminary report of the United States Coal Commission made public on July 8 is a unanimous report and was signed by the following members of the commission: John Hays Hammond, a mining engineer, chairman; Thomas R. Marshall, former vice-president of the United States; Clark Howell, editor of the Atlanta *Constitution;* George Otis Smith, director of the Geological Survey; Edward T. Devine, an authority on social relations, and Charles P. Neill, former commissioner of labor.

In the beginning the report points out that the fundamental fact in the anthracite coal problem is that heretofore the limited and exhaustible natural deposits have been in the absolute private possession of their legal owners, to be developed or withheld at will, to be released for such royalties as could be exacted, to be transported and distributed at such rates and in such manner as a doubleheaded railroad and coal combination might find most advantageous, and to be sold at such prices as could be maintained by the restriction of output and the elimination of independent competitors. The commission does not recommend the abolition of existing property rights nor does it recommend government ownership either by purchase at present value or by expropriation. It does, however, hold the view that a limited natural monopoly like anthracite held by a relatively small number of individuals and supplying a necessity for millions of people cannot continue to be treated as if it were not affected by a public interest.

Considered Public Necessity

Coal is quite as much a public necessity as gas, street railway service, railroads, and like them should be required to report to a public authority and be subject to regulation in the public interest and should have no secrets from the public in regard to mining costs, profits, salaries, wages, or corporate relations. The commission believes that the principal of individual and corporate responsibility should be maintained as most likely to insure economical and efficient management of the industry, and that the public interest may be adequately safeguarded by the creation of a governmental authority with power to require financial and operating reports, to prescribe uniform methods of cost accounting, and to determine the conditions on which coal may be shipped in interstate commerce.

It is recommended that the president of the United States be authorized by act of Congress to declare that a national emergency exists whenever, through failure of operators and miners in the anthracite industry to agree or for any other reason, there is a suspension of mining operations; and to take over the operation of the mines and transportation and distribution of the product with full power to determine wages and price at which coal shall be sold; and subject to court review, the compensation to be paid to land and mine owners.

Am. Soc. C. E. Board of Direction Protests Ousting of Davis

Engineering News-Record Staff Report

Preparation of a strong statement decrying the removal of A. P. Davis from the directorship of the Reclamation Service, and approval of the Executive Commitee's action in starting an investigation into Secretary Work's summary dismissal of Mr. Davis, were features of the session Monday and Tuesday of the Board of Direction of the American Society of Civil Engineers, previous to the summer convention being held in Chicago this week. The statement will be read at the business meeting of the society, July 11.

The Board also approved the report of the secretaries of the four founder societies favoring a joint engineering employment service, final approval of the plan to rest with the membership of the four societies. The present employment service is to be discontinued and the joint plan made effective Sept. 1. Branches of the service will be installed in various centers of engineering activity later on.

The Committee on Registration of Engineers was instructed by the Board to present a model law to the Board 30 days in advance of the fall meeting, to be held in Richmond, Va., Oct. 15. Because of his activity in connection with work on the Illinois engineers' license law, T. L. Condron was added to the Committee on Registration of Engineers.

Other action taken by the Board included approval of resolutions expressing regret for the death of Rudolph Hering and John Shoemaker, the latter killed June of last year in the clash between union miners and strike-breakers at Herrin, Ill.; and approval of a petition seeking the establishment of a city planning division of the society. Five technical divisions have now been organized or authorized. Four of these, dealing with the sanitary, highway, irrigation and power fields, were organized at the annual meeting of the society held in New York City Jan. 17-19.

The Board voted to hold the 1924 spring meeting at Birmingham, the summer convention at Pasadena, Calif., and the fall meeting at Detroit.

An analysis of the consumer's dollar, based on November, 1922, prices, shows that in New York every dollar paid for 145 lb. of coal; 56c. of the dollar went to the mine operator, 18c. to the railroads, and 26c. to the dealer. In Washington, the consumer's dollar paid for 141 lb. of coal and was distributed as 58c. as the mine price, 20c. as freight, and 22c. to the dealer. In Chicago, the dollar paid for only 120 lb. and was distributed as 49c. as mine price, 30c. as freight, and 21c. to the dealer.

As so large a part of the consumer's dollar goes to freight charges, the commission recommends that the Interstate Commerce Commission make further investigation of the reasonableness of the present anthracite rate. In view of the three successive jumps of approximately a dollar in the mine price of coal in the past three years, which is largely charged to labor, the commission has undertaken an extensive inquiry into the cost of living, the earnings, and other conditions surrounding the mine workers. The income of a family of five ranges in general from $1,500 to $2,000 for those who avail themselves of the opportunity to work the year round.

Basis of Income

The commission has found itself confronted with conflicting claims as to the basis upon which the rate of income should be reckoned. Cost of reproduction might well be reported as a fact with reference to the plant and equipment, but as the greater part of the investment claimed by the company is in coal-bearing land, reproduction cannot apply to these lands, because the lands cannot be reproduced. Nor is present market value a satisfactory basis, as there is no market for such lands in the accepted sense of the word.

In discussing the relation of production to the increase in population, the commission points out that the most significant fact is the progress made in twenty years in decreasing the wide gap between mine capacity and actual output; with approximately the same number of mine workers, the production was 50 per cent greater in 1920 than in 1900.

On the matter of the miner's rights, the commission says that the principle that a man has a legal right to work free and unimpeded and for whomsoever he choose; that another man has a legal right to employ and discharge as he pleases, and that men have a right to bind themselves together for collective bargaining are freely admitted by every one. These principles, honestly lived up to, would keep the open shop and at the same time permit the existence of the unions. But, as a matter of fact, the closed shop in a unionized mine is open to the union miner and closed to the non-union miner, while the open shop in the non-union mine is open to everybody save a United Mine worker. Neither side can show absolutely clean hands in keeping and helping to enforce the civil rights of American citizens.

The commission makes the following recommendations for the prevention of strikes:

"1. The commission recommends that in the next agreement there should be a provision for a continuing umpire and that he or an assistant named by him should sit with the Conciliation Board at all its meetings, but without a vote.

"2. That alternates should be selected with authority to act in the absence of the original member.

"3. The operators' group should appoint a full-time representative and all necessary assistants to consider jointly with the district officers of the union each case before it is appealed to the Conciliation Board in the hope of securing a local agreement, thus producing a mutual feeling of respect for the other's opinion and each obtaining the outlook of the other upon the problems.

"4. So many changes have taken place since 1903 that the agreement should provide for a joint committee to work out a restatement of the whole agreement in the terms of today, and this agreement should be specific enough to be the code by which all persons having anything to do with the settlement of grievances shall be bound.

"5. If the Board of Conciliation does not clearly understand the facts involved in any case, it should appoint an examiner from each side immediately to investigate and furnish it with all the facts.

"6. The agreement should provide for penalties for the breach thereof by either party, and the method by which such penalties are to be enforced.

"7. The renewed agreements have too rigidly retained the practices and conditions of 1902 and have not had adequate flexibility. A second joint committee should be provided for in the next agreement and directed to make an engineering study of the elements of the job of mining anthracite coal, for the purpose of building up a scientific and more equitable basis for rate making.

"8. The expiration of the contract in the anthracite region should not coincide with the expiration of that in the bituminous region. The contract should run for a definite period of time with the proviso that it shall be deemed to be renewed for a like period of time except as to such provisions thereof in which notice of a desired change shall have been given by either party to the other at least ninety days before the renewal date. Upon these proposed changes the parties shall immediately confer and if, sixty days before the date fixed for the renewal of the contract, they have been unable to agree, they shall report such fact to the President of the United States, specifying clearly the controverted points. The President shall thereupon appoint a person or persons to inquire into and make public a report upon all the relevant facts in controversy before the date of such renewal shall have arrived."

Conclusion

In conclusion the commission recommends at this time no punitive legislation. It awaits with interest whether the next agreement entered into shall show a co-operative spirit, a clear idea of partnership on the part of all concerned, and a proper conception of the rights of the American people. It points out that both the operators and the United Mine Workers are giving out information which apparently is intended to inflame the public mind for or against one of the parties, instead of informing the public as to what will be justice to both operator and miner.

Random Lines

Naval Engineering

In commenting on the sabotage of the "Vaterland," now the "Leviathan," former Secretary of the Navy Daniels explains as follows:

"On examination, the complete report by Captain Jessop will show other acts of sabotage, such as the removal of the propeller shafts, which would have permitted the seepage of tons of water into the hull of the ship and thereby cracked in the high pressure cylinder."

The mystery is how the binnacle, the foretopmizz'nm'st and the bos'n all escaped injury.

* * *

This Week's Grist

"Read what Henry F. Woods, Secretary of the Forgery Prevention Bureau of New York, has to say as to what the Todd Protectograph Co. has accomplished for Business America. Then call a Todd Forgery Prevention Engineer at Seneca 0571. He will gladly give you a visible demonstration of the story."—From a Buffalo newspaper.

Lauterbach,
1826 W. Pratt St.
Paint Engineer

A hand bill from Baltimore.

At a recent meeting of the Buffalo City Council the gentlemen who remove the garbage cans from the back doors were referred to as "sanitary engineers."

Sir—"Having noted, in my weekly quota of reading, the advertisements of Smart, Clever, and Sharks as "clothing engineers," I felt thoroughly vindicated, as an "ornery" civil, when I saw the spirit of retaliation manifested in an ad. of the products of a steel works, who emphasized their "hand-tailored boilers." E. F.

* * *

Warning Mr. Ashburner

The new city manager of Stockton, Calif., has good cause for action against the make-up man on the Washington *Star* who perpetrated the following sequence of news and philosophy:

NORFOLK, Va., June 23.—Charles E. Ashburner, city manager of Norfolk, and the first man to hold that position in the United States, resigned today to accept the place as city manager of Stockton, Calif., at a salary of $20,000 a year.

Fortune, when she caresses a man too much, makes him a fool.

Philadelphia Resumes Construction of Delivery-Loop Subway

Bids have been called by the Department of City Transit, Philadelphia, for construction of part of the delivery-loop subway, authorized in 1916 and begun shortly after. The portion to be put under contract includes 1,529 lin.ft. of the Arch St. leg of the loop. It is double-track structure of box section. About 300 lin.ft. of sewer besides intercepting sewers along the sides of the subway are included. Two short sections at each end of this one were constructed in 1917. It is planned to complete subway construction on this side of the loop eastward to a point near Eighth St., where the line is subject to change under revision of the plans now being considered.

As contemplated before the war, Philadelphia subway construction was to include the delivery loop in conjunction with a main trunk line north and south in Broad St., of which, however, only the section under the city hall, all of which forms a station, was built. Recently the administration, after the Frankford elevated line was placed in operation last November, proposed to place under contract a 13,000-ft. section of the Broad St. subway, beginning at a point 7,000 ft. north of the city hall and extending to Venango St. Changes in routing that have been suggested since the work was originally planned would not affect this portion. However, the city council repealed the ordinance appropriating funds for the Broad St. section. The appropriation for the delivery loop through Arch, Eighth, and Locust Sts. was not affected by this repealer. A commission of the council, including representatives of business organizations, is now considering the question of revising the authorized lines. It is working in conference with engineers of the Department of City Transit and of the Philadelphia Rapid Transit Co. The report of this commission is expected to be a necessary preliminary for further subway construction.

Marx Becomes Emeritus Professor at Leland Stanford

Charles D. Marx, professor of civil engineering at Leland Stanford Jr. University (Palo Alto, Calif.), retired at the end of the recent term and became professor emeritus. He went to Stanford in the opening year, has served the institution with great credit, and leaves under the university regulation that retires faculty members at the age of 65. For many years he has been prominent in activities of the Am. Soc. C. E. of which he has served successively as director, vice-president and president. When the San Francisco Engineering Council was organized some years ago to represent all technical societies having branches at San Francisco, Professor Marx was selected as president and each year has been re-elected to that office. A review of his professional record was published in *Engineering Record*, Jan. 23, 1913, p. 124.

C. B. Wing, professor of structural engineering at Leland Stanford Jr. University, becomes head of the civil engineering department. The faculty in this department is to be strengthened by the addition of L. B. Reynolds of the Burns & McDonnell Engineering Co., Kansas City, Mo.

Pennsylvania Soon to Organize State Traffic Police

The vanguard of Pennsylvania's traffic inspection force, authorized in a bill recently signed by Governor Pinchot, will be on the roads within a month, according to word emanating from the State Department of Highways last week. The legislation authorizes the highway commissioner of the state to employ such men as he deems necessary to enforce the penal provisions of the motor laws. Particular attention will be paid to the correction of the following evils, says Paul D. Wright, highway commissioner: Overloading of trucks, excess speed of all motor vehicles, and misuse of headlamps.

It is the intention of the commissioner to drive from the road the five per cent of road users who endanger the lives of all those who travel the highways. As an indication of the problem Pennsylvania faces in the correction of the headlamp evil, it is said that there are 150 different headlamps and devices approved by the department, many of which are declared to be obsolete. Also, there is almost as wide a divergence in the lenses used, so that the combination makes night traveling one of the most difficult of the problems concerned with road traffic in Pennsylvania.

The traffic inspection force is to be uniformed. Those police who will supervise speed of vehicles will use motorcycles, while automobiles will be used by those in the inspection force who are on the lookout for violations of the laws governing truck weights. Scales will be carried by these machines and whenever overloading is suspected, trucks will be weighed.

Kansas Contractor Goes to Work

DURING a recent flood in Kansas, caused by continued excessive rains, several cities were inundated by flood waters from the Arkansas River. Herewith is a photograph of the principal street of Wichita, Kansas, Douglas Ave. Irwin Hale, a general contractor of that city, is en route to his work. The current of the flood waters is considerable, as the picture indicates.

Wisconsin Bill Proposes State Acquisition of Water Power

The Wisconsin Legislature in session at Madison, has before it for consideration a bill which will amend the state constitution so as to permit the state to go into debt, by issuing securities, in order to buy hydro-electric power plants and water-power sites. The bill has passed the lower house and is expected to pass the Senate shortly.

Illinois Central R.R. Completing Chicago Yard

Work is being pushed on the large terminal freight yard of the Illinois Central R.R. at Chicago and it is expected to have the greater part of the yard in service before the end of the year. This Markham yard, just south of Harvey, Ill., 18½ miles from the Chicago passenger terminal, will be the main-line freight terminal for the Chicago district, where inbound trains will be broken up and outbound trains made up. All movements north of this yard will be switching and transfer service. This freight terminal was begun in 1918 (see *Engineering News-Record*, Aug. 15, 1918, p. 313) but work has been delayed by various causes. About $2,500,000 has been spent, mainly on the filling to raise the site to grade, but $6,000,000 will be required for completion. For northbound and southbound traffic there will be two separate units, each consisting (for the present construction) of a 10-track receiving yard, a 10-track departure yard and a classification yard with hump for gravity switching. The northbound classification yard will have sixty tracks for 2,400 cars and the southbound yard will have forty tracks for 2,000 cars. Double the number of tracks in each yard is provided for by the general plans. In addition there will be an engine terminal and a transfer station for rehandling l.c.l. freight.

The design and construction of the terminal yard are under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.

Let First Contract on Moffat Main and Pilot Tunnels

The letting of a contract July 5 for electric power (3,000 hp.) for driving the 6-mile Moffat Tunnel under James Peak, just west of Denver, marks the initial step in the expenditure of a bond issue of $6,720,000 by the Moffat Tunnel Commission. A pole line 29 miles long from the Colorado Power Company's plant 5 miles west of Boulder is to be completed within 90 days and ready to deliver power at both east and west portals. The cost is approximately $65,000 and the contract price for current will average about 1c. per kw.-hr. When completed traffic through the tunnel will be operated electrically with current over the same pole line.

Successful sale of the 5½ per cent bonds late in June at a premium of $215,000 followed the action of the U. S. Supreme Court in validating the bonds by decision handed down June 11.

W. P. Robinson, president of the commission, states that he hopes to have the work under contract by Aug. 10 and actual construction started by Sept. 1. A chief engineer and staff will probably have been appointed by the time this is printed. Tunnel contractors have been notified of the work and the public advertisement will be made the latter part of July, a minimum of 10 days only being required.

The commission of five members, who serve without pay, was appointed by the governor immediately after the law went into effect. Their successors were voted upon July 10 but the only nominees were the appointees. D. W. Brunton, J. Vipond Davies and J. Waldo Smith are the consulting engineers.

Missouri Highway Department Loses Freight Rate Suit

The Missouri Public Service Commission July 3 dismissed the complaint filed by the State Highway Commission against all the railroads of the state, demanding a reduction in intra-state freight rates on road building materials. The dismissal was without prejudice to the right of the Highway Commission to apply to the Public Service Commission for specific rates on road building materials between given points within the state.

The commission held that to grant the highway body's request and lower rates for general application between all points in the state upon all shipments of road building materials would result in undue discrimination against interstate commerce in the same commodities, which is prohibited by the interstate commerce act.

A ruling of the Missouri Supreme Court in a similar case against the Missouri, Kansas and Texas Ry. Co., was cited to support this view.

Pinchot Gets Bill Seeking Repeal of Engineers' License Law

Both legislative and judicial opposition to the engineers' license law has been raised in Pennsylvania. Governor Pinchot has now before him a measure seeking the repeal of the registration law, upon which action must be taken by July 13. There is little exact knowledge concerning Governor Pinchot's attitude on the bill, though it is the personal view of a number of engineers of high repute in the state that he will veto the repealer.

Judicial opposition to the bill is embodied in a decision handed down July 2 in a lower court by Judge Samuel E. Shull, of Stroudsburg, who decreed that the 1921 law creating the registration board is unconstitutional. The decision was the result of a test case wherein George D. Stevenson, a civil engineer of Scranton, was arrested about a year ago for practising his profession without first obtaining a license.

Forty-Year-Old Bridge Destroyed by Colliding Automobile

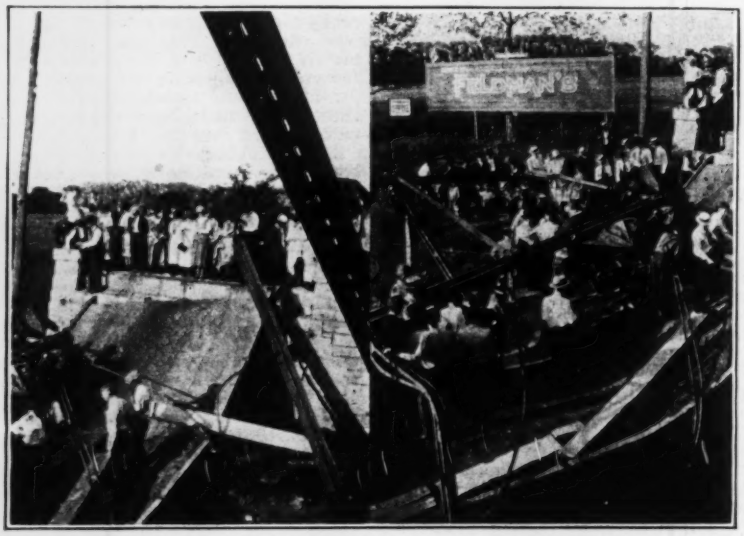
An old iron truss highway bridge crossing Pushta Creek near Wapakoneta, Ohio, was wrecked on the night of June 2 by an automobile which struck the end post while traveling at high speed. Chalmers S. Brown, of Lima, reports the accident as follows:

"The bridge, built in 1883, was a pin-connected through Pratt truss structure of 88 ft. span, with a clear roadway of 16 ft. The trusses were 15 ft. high and comprised eight panels of 11 ft. The floor was a 2 in. bituminous mat laid on a subfloor of 3 in. oak plank over 3 x 12 in. oak joists spaced 18 in. between centers.

"A large touring car carrying six people approached the bridge from the west at a speed of about fifty miles per hour. The approach to the bridge is on a down grade of 2.3 per cent, and has a curve to the right of 500 ft. radius and 19 deg. central angle which ends 40 or 50 ft. before the bridge is reached. The driver managed to pilot the car into the bridge entrance but in such a manner that the left running board was crushed against the left batter post and the left rear wheel struck the face of this post squarely, knocking the post off the abutment and causing the entire bridge to collapse.

"The speed of the car was such that it reached the last panel of the bridge before the superstructure fell upon it. The line of travel of the car was close to the left-hand guard rail. The top chord of the right-hand truss fell diagonally across the car, crushing the windshield and top and killing one passenger in the front seat and fatally injuring one in the back seat. The damage done to the car by the falling superstructure indicated that the car had come almost to a stop before being struck from above.

"It is interesting to note the heavy floor construction, the estimated weight of which is 42 lb. per square foot or about equal to the total original dead load. The bridge had withstood heavy traffic and was pronounced by engineers safe for ordinary service."



EAST PORTION OF WRECKED BRIDGE

West end post of north truss knocked off abutment and both trusses overturned toward north. Photographs taken from electric railway bridge near.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The San Francisco Section, Am. Soc. C. E. at the bi-monthly meeting on June 19 had as guest of honor Professor C. D. Marx, recently retired from thirty years of active service as head of the civil engineering department, Stanford University. As a token of esteem and in appreciation of his long service, members of the section presented Professor Marx with a pipe banded with gold and suitably engraved. The topic for the evening's discussion was "The Investigation of California's Water Resources."

Personal Notes

DR. GEORGE A. SOPER, consulting engineer, New York City, has been appointed managing director of the American Society for the Control of Cancer. Besides his notable investigations of water treatment and sewage disposal, the latter including years of study while member and president of the Metropolitan Sewerage Commission of New York, Dr. Soper has conducted much epidemiological work, particularly during typhoid outbreaks and while in the office of the Surgeon General, U. S. A., during the World War.

F. D. MARQUEZ has resigned as superintendent of public works in Porto Rico, under the United States Department of the Interior, to become commissioner of public works of the city of San Juan.

FREDERICK L. RANSOME, formerly assistant in geology at Harvard, and since 1913 in charge of sections of western work for the U. S. Geological Survey, has accepted the position of professor of economic geology at the University of Arizona. He is a graduate of the University of California.

A. L. FERVER, for two years director of public service in Long Beach, Calif., has resigned and will be associated with James F. Collins, development engineer, in that city.

JAMES OGDEN has succeeded F. S. Benson as city manager of Bakersfield, Calif.

PROF. IVAN C. CRAWFORD, associate professor of civil engineering at the University of Colorado, will become dean of the college of engineering, University of Idaho, this fall.

R. SCOTT KIFT, civil engineer, Lock Haven, Pa., was elected as borough engineer for Lock Haven to succeed W. F. Cowley, who will locate at Birmingham Ala.

W. C. KEGLER, engineer of maintenance-of-way on the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed engineer of track and roadway, with headquarters at Cincinnati, Ohio.

RICHARD CASE has been appointed assistant town engineer of Phillipsburg, N. Y., to succeed BERNARD P. MONOHAN, resigned. Mr. Case has been connected with the engineer's office of the town for eight years.

T. E. HUFFMAN, county engineer of Denton County, Texas, in charge of the $2,000,000 highway program for the past four years, has resigned upon completion of the major portion of the work, and H. T. BREWSTER, resident engineer, has succeeded him.

W. S. BELLOWS, Oklahoma City contractor, and W. H. MACLAY, recently of the Central Contracting Co., Dallas, have opened offices as general contractors at 1217 Kerby Bldg., Dallas, under the firm name of Bellows-Maclay Construction Co.

EDWIN F. WENDT, of Washington, D. C., has been selected as consulting engineer on valuation for the Toledo, St. Louis and Western R.R. Co.

M. M. LEIGHTON has been appointed chief of the Illinois State Geological Survey, with offices at Urbana, Ill., succeeding F. W. DeWolf who resigned.

R. T. HOYT CONSTRUCTION Co. has been organized in Colorado Springs, Colo., with the following as principal members of the firm: R. T. Hoyt, F. L. Grandon and Paul T. Barrett.

MAJOR A. B. CUTTER, former city engineer of Everett, Wash., has been appointed resident engineer for the recent $850,000 bond improvement program at Bluefield, West Virginia. The bond election carried on June 19.

W. F. COOPER, of Union Parish, assistant highway engineer of the Louisiaa Highway Commission, has been appointed by Governor John M. Parker to succeed Arthur Taylor, of New Orleans, as a member and vice-chairman of the commission.

CLYDE POTTS, consulting engineer, New York City and Morristown, N. J., has been elected vice-president of the New Jersey State Board of Health.

ROY A. KLEIN has been made chief engineer of the Oregon State Highway Commission. Mr. Klein, who succeeds Herbert Nunn, retains the position of secretary of the Highway Commission which he has held for several years. Since the resignation of Mr. Nunn, Mr. Klein has been serving as acting chief engineer of the commission.

THOMAS J. WASSER, former chief engineer of the New Jersey State Highway Department, has been engaged by the Public Service Production Co., a subsidiary of the Public Service Corporation of New Jersey. Mr. Wasser will take charge of all road work in his newest association.

R. T. REGESTER and G. E. STONE have established the firm of Stone & Regester, consulting engineers and contractors, with offices in Baltimore, Md. Mr. Regester has been construction engineer of the Loyola Construction Co., Baltimore, and Mr. Stone has been assistant highway engineer.

ORRIN E. STANLEY, for several years sewer engineer, department of public works, Portland, Ore., has been appointed chief of the bureau of maintenance in that department, following the resignation of R. S. McMullen. C. H. SMITH is the new sewer engineer.

H. L. TROTTER and C. L. CATE have formed a partnership under the firm name of Trotter & Cate, consulting engineers, with offices in Montreal. Henry Holgate will be connected with the firm as associate consulting engineer. Col. Trotter is a graduate of the Royal Military College, Kingston, and has worked with Ross & Holgate, consulting engineers, and for Morrow & Beatty in British Columbia. Mr. Cate is a graduate of McGill University and besides doing hydro-electric work with the Foundation Co., Ltd., has been a consulting electrical engineer.

H. B. VOORHEES, general manager of the New York terminal of the Baltimore & Ohio R.R., has been promoted to be general manager, western lines, with headquarters at Cincinnati.

L. S. ROSE, assistant to the general manager of the Big Four Ry., has been appointed general manager of the Peoria & Eastern, with headquarters at Indianapolis, Ind.

DR. W. R. WHITNEY, director of the research laboratory of the General Electric Co., was recently elected a member of the corporation of the Massachusetts Institute of Technology for a term of five years. CHARLES R. MAIN, consulting engineer, Boston, was also elected to the corporation. Both men are graduates of the school.

THEDORE E. VELTFORT, who for ten years has been assistant to the district construction manager in the Chicago office of Stone & Webster, Inc., has been transferred to the structural division of the company in the Boston office.

HOWARD A. HOLMES, construction engineer of the Montana state highway department, has been appointed chief engineer of the highway commission of that state, succeeding John N. Edy, who has gone to California.

JAMES ALLEN, formerly state highway supervisor of Washington under the department of public works, has now been designated state highway engineer reporting directly to the State Highway Commission.

BERNARD L. CROZIER has been appointed highway engineer for Baltimore, Md., succeeding CHARLES F. GOOB. Mr. Crozier has been connected with the engineering forces of the Baltimore & Ohio R.R., United Railways & Electric Co., Maryland State Roads Commission and the Baltimore Paving Commission.

JOHN A. MACDONALD has been appointed highway commissioner of Connecticut to succeed C. J. Bennett, who resigned July 1 to enter the construction business. E. C. WELDIN, former division engineer, has been named deputy commissioner.

The WATSON ENGINEERING Co., Cleveland, Ohio, architects and engineers, has changed its corporate name to the Watson Co., in order that the name of the organization may describe more accurately the scope of the service it gives. The change became effective June 1. For sixteen years the services of the company have consisted mainly of design and supervision of construction of both architectural and engineering structures. The reconstructed firm offers to its clients coordinated personal services of a competent staff of architects and structural, mechanical, electrical, heating and ventilating engineers, all of whom have had specialized training and experience.

Obituary

JOSEPH G. LEGRAND, bridge engineer of the Canadian National Railways, Western region, died at Winnipeg July 2. He was born in France in 1861 and went to Canada at the age of 30. In 1900 he was appointed bridge engineer of the Grand Trunk Ry. and in 1920 to the position he held at the time of his death.

JOHN A. BRITTON, first vice-president and general manager of the Pacific Gas & Electric Co., died in San Francisco June 29, aged 68 years. He had spent most of his life in California, having gone to that state from Massachusetts at the age of thirteen. His schooling was cut short by the necessity of earning his own way and he entered the employ of the Oakland Gas Co. as collector in 1870, working up through the positions of secretary and chief engineer to the office of president. When the company was absorbed by the Pacific Gas & Electric Co. he again advanced rapidly in the larger field to the position held at the time of his death. As active head of the company he directed the affairs of one of the largest hydro-electric systems west of Chicago. He was an active participant in affairs of the civil, mechanical and electrical societies, and at the time of his death was the president of the Bohemian Club and a prominent leader in business and professional circles.

JULIO FEDERICO SORZANO, consulting engineer, died in Brooklyn, New York, June 25. Educated in France and Belgium, he had been engaged in the engineering field since 1879. Although established in New York, the greater part of his work was done abroad, principally in Cuba, Mexico, Puerto Rico, Haiti and the countries of South America. He designed and built a score or more sugar mills in Cuba and Puerto Rico alone, and was an acknowledged expert in matters pertaining to the raw cane and beet root sugar industries. He constructed the first railway built in Venezuela, as well as two subsequent roads in the same country. One of the first matters on which he was consulted here was in connection with the foundations of the Brooklyn Bridge towers with which there had been considerable difficulty. He was greatly interested and very active in the Panama Canal controversy over the relative merits of the lock canal as against the sea level canal, and the water supply available for the lock canal. Mr. Sorzano was a close student of Latin-American affairs, and in 1911 organized the Pan-American Chamber of Commerce. He was president of the institution up to the recent illness which culminated in his death. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Civil Engineers of Great Britain and la Société des Ingénieurs Civils de France.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Lubrication of Construction Equipment—Part II

How Contractors Can Secure the Maximum Service from Gears, Chains, Wire Rope and Concrete Mixing Machinery

(From Information Supplied by The Texas Co., New York.)

IN ORDER to preserve and maintain operation at the highest efficiency, it is essential to keep all gears, chains and wire rope well coated with a suitable compound which will serve not only as a lubricant, but also as a preservative. Wire rope in particular requires attention due to the possible hazard involved if internal strands are allowed to rust, wear and corrode. Although wire rope as constructed today contains a hempen core which is usually soaked in lubricant prior to the winding of the steel strands, the theory that this core will serve adequately to lubricate the strands and prevent wear, rust and corrosion during subsequent service should not be relied upon. Therefore, the exterior surface of the rope should be treated at frequent intervals with a suitable lubricant and preservative, which is capable of penetrating to the innermost strands during operation and not only re-lubricating the core but as well preventing wear at the points of contact of the strands.

Such a compound should be: Plastic at all temperatures; capable of being readily applied in a thin film without undue heating; free from acids and alkalis; non-evaporative; so tenacious and adhesive as not to drip or run off under abnormal pressures or temperatures; insoluble in water; non-hardening; capable of resisting the entry of dust, dirt, chemical fumes or salt water. The most suitable lubricant for this service is a pure petroleum compound having a viscosity of about 2,000 Saybolt at 210 deg. F. In some cases increased viscosity up to perhaps 5,000 may be necessary.

Gears and chains should be treated with a similar compound. There is relatively no hazard if they are neglected, but wear will develop abnormally accompanied by excessive noise and rattling, and corrosion of the wearing surfaces, especially if they are exposed to sea air, or acid fumes. Whatever the type of machine involved, the setting and aligning of gears is important, and all teeth should so mesh that there will be a uniform and constant application of power and smooth, quiet operation in order to insure against jerky action. This latter would tend to produce strains and abnormal wear, not only on the gears, but also on other driving mechanisms.

To attain best results in applying the gear lubricant the surfaces of all teeth should first be washed with kerosene or some other solvent, the lubricant being then heated and brushed or poured lightly onto the wearing surfaces while the gears are in slow rotation. Pressure between the teeth will adequately spread the lubricant, if it is applied in the proper amount, and it should not be forced over the sides of the gears unless the film is too thick. In this event the intensity of the application should be decreased.

Concrete Mixing Machinery

In construction work concrete mixers have become essential. Their rate of production is the prime factor governing the progress of the work, and possibility of break-down due to serious wearing of gears, overheated bearings or engine troubles which are traceable to faulty lubrication, should be carefully guarded against. Concrete mixers, at best, will receive the roughest kind of treatment. There is always a certain amount of dust grinding into bearings, gear teeth or other operating mechanisms, so that mixers should receive proper and sufficient lubrication throughout the job.

In general the lubrication of concrete mixers, whatever their type or design, can be effectively carried out by the use of three grades of lubricants: A gear compound; a suitable grade of grease or semi-solid lubricant for general bearing lubrication; and a power plant lubricant adaptable to the type of machinery used to drive the mixer. On gears, pinions, racks, sprocket wheels and chains, as well as wire rope, a heavy grade of petroleum compound having a viscosity of about 2000" Saybolt at 210° F. has proved to be the most dependable lubricant. Such gearing in general operates under considerable pressure and there is always a certain amount of dust, slush and water present. Therefore, a lubricant must be selected that will not only have sufficient viscosity to insure a dependable film and prevent metal to metal contact, but as well which will be so adhesive as to stick to the teeth and chains and resist the washing action of water as much as possible.

Grease or cylinder oils can be used on such gears but they are not as efficient as the heavier compound due to the presence of dust and to their tendency to absorb or accumulate fine particles of cement readily. They simply develop into an abrading paste instead of a lubricant. The heavier compound mentioned above, however, withstands such contamination to a marked extent.

Drum Roller Bearings

The bearings of drum rollers also require careful lubrication if the machine is to be kept in continuous service and breakdowns forestalled. If these bearings are not properly lubricated at all times the resultant wear, which will be brought about by the abnormally high down-thrust caused by the tumbling action of the materials within the drum, will result in flattened shafts and a certain amount of wobbling. Vibration, pounding, and distortion or misalignment of the entire mechanism will thereby follow. Certain manufacturers use roller bearings on the drum rolls, and certain other shafting, while others prefer split babbitted bearings equipped with grease cups.

Attention to Grease Cups

Where roller-bearings are used the most suitable lubricant will be a pure mineral product of the nature of petrolatum, a relatively heavy grade of liquid grease or a light compression cup grease. Grease cup service requires a heavier lubricant of about the same consistency as a medium compression cup grease. Attention to grease cups throughout the machine is very important. In daily operation they should be kept well filled with clean grease and screwed down at least twice a day in order to insure a sufficient film of lubricant in the bearings to prevent cement dust from working its way in along the shaft ends.

Roll surfaces and drum runways should never be lubricated, inasmuch as the presence of oil or grease on the frictional surfaces will reduce tractive effort. Such rolls are in general built of car-wheel metal in order to withstand the heavy duty required.

Lubrication of the power plant of a concrete mixer will, of course, depend upon its type. Where steam is used both internal (or cylinder) and external lubrication are required. Inasmuch as saturated steam is chiefly used, a compound steam cylinder oil of from 130 to 150" Saybolt viscosity at 210° F. will be suitable. This should be furnished to the cylinder at a rate of about five drops per minute by means of a dependable hydrostatic or force-feed lubricator. Care of a hydrostatic lubricator is important especially in freezing weather. During such operation whenever a shutdown is to be made for any length of time, both oil and water should be drained from the lubricator, in order to prevent freezing in the sight feed glass, and possible cracking.

External Engine Lubrication

The external lubrication of engine bearings and guides, etc., should be carried out in the manner explained heretofore, using either a high grade straight mineral oil suitable for service in ring oiling systems and drop feed oil cups, or a pure compression cup grease of light or medium grade according to the prevailing temperature involved. In general, grease lubrication is preferred by most mixer builders and their machines are therefore usually equipped with compression grease cups.

Where internal combustion engines or electric motors are used to drive the mixer lubrication is similar to that recommended for excavating machines equipped with similar power plants. All such machinery is subjected to the same severity of operation. Hence, motor bearing lubricants of from 180 to 200" Saybolt viscosity at 100° F. will be most suitable on electric drive mixers; and the usual grades of automobile and tractor engine lubricants will serve the purpose on internal combustion engines.

Messinger Becomes President of the Chain Belt Co.

C. R. Messinger, vice-president and general manager of the Chain Belt Co., Milwaukee, since 1917, has been appointed president, succeeding William C. Frye who retires from active participation in the company's affairs after a service of 28 years with the organization, including 7 years as its administrative head. Under Mr. Frye's leadership the company has maintained a steady growth, inaugurated by C. W. Levally, founder and first president, in the production of chain, concrete mixers and conveying machinery, under the trade name of Rex.

Mr. Messinger joined the Chain Belt organization in 1917 after 8 years as general manager of the Sivyer Steel Casting Co. He is also president of the Interstate Drop Forge Co., vice-president of the Sivyer Steel Casting Co., vice-president of the Federal Malleable Co., all of Milwaukee, and a director in the Nugent Steel Castings Co. of Chicago and the First Wisconsin National Bank of Milwaukee. During the term 1922-23 Mr. Messinger was president of the American Foundrymen's Association and is also prominent in the affairs of the American Malleable Castings Association.

Recommend Fewer Varieties of Structural Concrete Units

Washington Correspondence

Recommendations for the elimination of a number of sizes of structural and partition units made of concrete were endorsed by committees representing the Concrete Products Association and the American Concrete Institute at a preliminary meeting held in Washington, D. C., June 21 with the Division of Simplified Practices of the Department of Commerce. The committees expressed a desire for a general meeting of all interests concerned in the subject next October to consider adoption of the recommendations.

The tentative recommendations are the result of a survey made under the direction of Wallace R. Harris, chairman of the Committee on Standard Building Units of the American Concrete Institute. This survey showed concrete blocks made in 30 different lengths, 20 widths and 26 heights.

The tentative recommendations for foundation units are: Height, 7⅝ in., length, 15⅝ in., with wall thicknesses of 8 and 12 in. For load bearing wall units the recommendations are: Height, 7⅝ in., length 15⅝ in., and wall thicknesses of 6, 8, 10 and 12 in. For load bearing concrete structural tile the recommendations are: Height, 5 in., length, 11⅝ in., and wall thicknesses of 4, 8 and 12 in. For concrete partition tile (non-load bearing) the recommendations are: Height, 7⅝ in., length 16, 18 and 24 in., and width 3, 4, 6 and 8 in.

Attending the preliminary conference were: Herbert A. Davis, representing both the Concrete Products Association and the American Concrete Institute; C. E. Lindsley, American Concrete Institute; L. L. Wagner and John L. Miner, Concrete Products Association; P. E. Holden and E. W. McCullough, Chamber of Commerce of the United States; and R. M. Hudson, assistant chief of the Division of Simplified Practice.

George L. Buff, Instrument Maker, Dies

Head of Well Known Firm Began Work at 17 in German Shop and Established Own Business in New York in 1870

GEORGE L. BUFF, head of the Buff & Buff Manufacturing Co., which for years has supplied surveying instruments for notable engineering projects throughout the world, died July 5, at the age of 84. Such works as the Panama Canal, the Catskill Aqueduct, the Union Pacific, New York, New Haven & Hartford, and Mexican Central Railways, to say nothing of thousands of triangulation surveys and scores of long tunnels, mines, highways and waterways have depended for their location, alignment and precise control of line and grade on the transits and levels produced by the organization established by Buff in Fulton St., New York, in 1870, and later moved to Boston.

Born in Giessen, Germany, in 1839, of the family which furnished Goethe with the *Lotte* (Charlotte Buff) for "Werther's Leiden," George L. Buff left home at the age of 17 to enter the factory of Repsault & Co., Hamburg, manufacturers of scientific instruments. Two years later he went to York, England, as foreman in charge of the large astronomical instrument shops located there. For six years he devoted his efforts to the finest sort of mechanical workmanship and with this training as a foundation emigrated to New York in 1864 to associate himself with the firm of Stackpole & Sons, well known instrument makers.

Business Established in 1870

In 1870 he established his own business on Fulton St., New York, and a year later entered into a partnership with C. L. Berger under the firm name of Buff & Berger, which continued 27 years, and won a nation-wide reputation for the excellence of its products. This partnership was dissolved in 1898 when Mr. Buff took his three sons into a newly formed organization under the name of the Buff & Buff Manufacturing Co., with a manufacturing plant in Boston.

Speaking of his work, one of his friends has said: "Buff made beautiful instruments for the love of it; he was indifferent to wealth. He created designs to fulfill certain requirements and brought them into being with unexcelled faithfulness and accuracy of workmanship. The sturdy beauty of his designs, their consistency of proportion and their extreme and faithful accuracy made his instruments world-famous. Even after his organization had expanded he insisted upon personal supervision of the individual construction of each instrument manufactured."

CHARLES CLIFTON, of the Pierce-Arrow Co., was re-elected president of the National Automobile Chamber of Commerce at the annual meeting in New York, June 7.

Business Notes

A. F. MCCLINTOCK has been appointed assistant sales manager of the Reading Iron Co., Reading, Pa.

BUCYRUS CO., South Milwaukee, Wis., manufacturer of power shovels, and excavating and dredging equipment, announces the appointment of E. J. Wilkie as northern sales manager, succeeding E. R. Weber, resigned. Mr. Wilkie will have general charge of the sale of Bucyrus products in Wisconsin, Minnesota, North and South Dakota, Michigan and Montana, with headquarters in South Milwaukee.

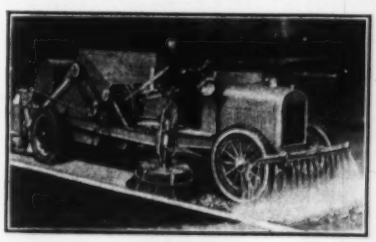
E. M. BREED, for several years assistant manager of sales for the Pelton Water Wheel Co., San Francisco, has been appointed sales manager with headquarters in San Francisco. Mr. Breed has had a wide experience in hydro-electric work, having been connected with the Pelton company in various capacities for the past fifteen years.

CHAMPION ENGINEERING CO., Kenton, Ohio, has opened a new sales office in Chicago to take care of increasing business in the crane and caterpillar sluice gate lines. This office will be in charge of W. B. McCracken, transferred from the company's operating department to the sales department.

Equipment and Materials

Pick-up Motor Street Sweeper Has Gutter Cleaning Attachment

A one-man motor-driven pick-up street sweeper with auxiliary gutter cleaning attachment and water sprinkling system has been designed by the Foamite-Childs Corp., Utica, N. Y., and machines of this type are already in service in the cities of Augusta, Ga.,



Elmira, and Massena, N. Y. The equipment consists of a rotary broom 32 in. in diameter and 6 ft. wide mounted at the rear of a Reo speed wagon and delivering into an inclined conveyor which discharges into a closed storage hopper of 50 cu.ft. capacity. Tests have indicated that the machine operates most effectively at a speed of 9 miles per hour.

The rear broom is built up on a grooved wooden core, with end castings to protect the fiber, and is filled with either steel or split bamboo. As the broom wears, the distance between broom and conveyor is automatically shortened to insure uniformity in the delivery of street dirt to the conveyor.

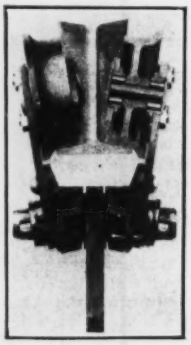
The conveyor drive is equipped with wood shear pins which break at the entry of any large heavy object which might foul the machine. The broom also stops when the shear pins break. The conveyor is of the rubber squeegee type with removable bottom. The dirt storage hopper has a smooth interior, without shelves or bridges, so that dumping can be done quickly and completely.

The gutter broom at the side of the machine works automatically in and out along the curb, brushing the dirt out under the sweeper where it is caught by the large broom at the rear. The gutter broom has a steel fiber filling 42 in. in diameter built in six segments that are easily removed and replaced when the broom wears. A feature of the sweeper is that both rear and gutter brooms may be made to revolve while the sweeper stands still.

The water sprinkling system in front of the machine consists of a 150-gal. galvanized iron tank with brass strainers at intake and outlet from which water runs by gravity to a rotary gear pump that forces water to the nozzles.

Roller Bearing I-Beam Trolley

A combination of strength and flexibility was sought in the design of the steel-plate, roller-bearing I-beam trolley which the Yale & Towne Manufacturing Co., Stamford, Conn., has placed on the market. The equipment, as shown in the illustration, consists of a pair of flanged wheels attached to side plates from which a shackle plate is supported by a single equalizing pin. The trolley has a rated capacity of 2 tons, although under test it has sustained a load of 14 tons. To each side plate are riveted spreader castings which give a large bearing surface for the equalizing pin and are so shaped as to protect the trolley and act as a bumper which engages the track stop on the lower flange at the end of the I-beam track. The axles are set at the same angle as the surfaces of the I-beam flanges and are pressed into wheel hubs and supported by inner bearing plates subjected to practically no bending strain.



The non-rigid construction of this trolley, its manufacturer claims, allows it to pass around a curve of sharp degree without binding.

Publications from the Construction Industry

Caterpillar Type Mounting—ERIE STEAM SHOVEL CO., Erie, Pa., has issued a 20-p. illustrated bulletin featuring its lubricated caterpillar type mountings for power shovels. The lubrication system is explained in detail and another feature emphasized is the use of removable bushings on the link pin bearings.

Wood Preservation—C. A. WOOD PRESERVER CO., St. Louis in a 44-p. booklet entitled "Evidence" presents data indicating the effectiveness of its carbolineum treatment to prevent rot and decay of timber. A number of testimonial letters indicate the value of wood preservation in a variety of uses.

Motor Vehicle Statistics—NATIONAL AUTOMOBILE CHAMBER OF COMMERCE, New York, has recently published the 1923 edition of its "Facts and Figures of the Automobile Industry," a book of 96 pp. illustrated. The publication contains a considerable amount of data of interest to highway engineers and contractors, covering the registration of motor vehicles, annual production of trucks and passenger cars, notes on motor vehicle taxation, mileages of federal-aid roads, motor vehicle revenue and similar statistical data.

Reinforced-Concrete Pipe—LOCK-JOINT PIPE CO., Ampere, N. J., in a 12-p. illustrated pamphlet, presents details of its three types of joint: Lead and iron; lead and steel; and copper. The text is supplemented by detail drawings.

Portable Hoists—SULLIVAN MACHINERY CO., Chicago, has issued two new bulletins, one on its single-drum and the other on the double-drum Turbinair portable hoists for scraper loading. These are reprints of earlier editions to which new matter has been added.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

To Survey Seasonal Operation in Construction Industries

Savings, not only to the building industry and its workers, but to the public generally are expected to result from the activities of a committee on seasonal operation in construction industries, the appointment of which by Herbert Hoover, chairman of the President's Conference on Unemployment, has been announced by the Department of Commerce. This saving should be reflected in lower relative cost of dwellings and other buildings. The members of the committee are:

Ernest T. Trigg, manufacturer, Philadelphia, chairman; John W. Blodgett, manufacturer, Grand Rapids, Mich.; John Donlin, president, Building Trades Department, American Federation of Labor, Washington, D. C.; L. F. Eppich, president, National Association of Real Estate Boards, Denver; A. P. Greensfelder, contractor, St. Louis; John M. Gries, Department of Commerce, Washington, D. C.; Otto T. Mallery, public works expert, Philadelphia; Rudolph P. Miller, engineer, New York; James P. Noonan, president, Brotherhood of Electrical Workers, Washington, D. C.; William Stanley Parker, architect, Boston; and Edward Eyre Hunt, secretary. The committee at a meeting this week expects to lay out plans for a thorough study of the facts.

Previous surveys have indicated that most construction activity is concentrated in seven to ten months of the year, which means that building trades workers can not find work in their trade during several months, and that contractors' organizations and equipment, architects, engineers, building material producers, and others connected with construction, must usually remain idle for similar periods. This idle time represents waste and direct losses to the construction industries themselves, their workers, and the public.

The committee was formed in the hope that by examining the facts and proposed remedies it might be able to suggest sound solutions and obtain general co-operation in effecting them. It is the general impression that seasonal building has been due perhaps more to custom than to weather, and it is expected that the investigation will throw light on this and other points.

Weekly Freight Loadings Pass Million Mark Four Times

For the third consecutive week and the fourth time this year, according to the Car Service Division of the American Railway Association, loading of revenue freight exceeded the million mark for the week ended June 23, the total for the week being 1,002,740 cars. Freight loading so far this year has been the heaviest in history. The total for the week of June 23 was an increase of 13.6 per cent, or 136,419 cars, over the corresponding week last year, and an increase of 227,293 cars over the corresponding week in 1921.

The total freight car loadings for this year (up to June 23) have been 22,991,055, as compared with 19,157,422 for the same period in 1922.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 11 to 28, are the following:

Office and sales building, Chicago, Ill., to Wells Bros. Construction Co., $8,000,000.

Hotel, Seattle, Wash., to Grant-Smith Co., $3,000,000.

Apartment hotel, Minneapolis, Minn., to Standard Home Bldg. Co., $1,300,000.

Dam and power house, Glens Falls, N. Y., to Parklap Construction Co., $1,000,000.

Power plant, Cahokia, Ill., second unit, to Fort Pitt Steel and Iron Works, Pittsburgh; two 40,000 hp. turbines, one to Westinghouse Electric and Manufacturing Co., East Pittsburgh, and the ther to General Electric Co., Schenectady, cost of both, $1,000,000.

Store and theater, St. Louis, Mo., to Mississippi Valley Steel Co., and Ben Hur Erecting Co., $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 11 to 28, are:

Store addition, Newark, N. J., for Goerke Co., $5,000,000.

Temple, Louisville, Ky., for Kosairs Association, $1,750,000.

Sanitarium, Ft. Worth, Tex., for Methodist Conference, $1,000,000.

Office building, Toronto, Ont., for Manufacturerers' Life Insurance Co., $1,000,000.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 60,000,000 to 75,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile Atlanta 4 @ 5 days); and stocks on hand in general terms, example: (brick, New York, scarcity.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Large reserve stocks	Enough, no large surplus	Del. 24 hr., local plant	Situation easier	Plenty	Sufficient	Equal to demands	Del. take 4 to 5 days	Small reserves in city
Cement	Stocks low	Scarcity increasing, due to demand	Normal	Ample	Immediate del. from nearby mills	Scarce	Ample	About 50 to 75 cars	Stocks in city small; mill shipments quick
Lime	Fairly well supplied	Enough, no shortage	Sufficient	Del. from mill on short notice	Plenty in warehouse; del. good	Plenty	Abundance	About 75 cars	Dealers' stocks small; mill del. prompt.
Common brick	Plenty	Sufficient for all demands	4,000,000 to 5,000,000 on hand	Plenty in yards	Fairly supply in local yards	Enough	Plenty; demand slowing up	Plenty	Scarcity
Hollow tile	Stocks in good condition	Strong demand; stocks holding out	Stocks normal	Dealers' stocks ample	Small stocks Del. take 5@6 days	Supply ample	Dealers' stocks sufficient	Del. take 4 to 5 days	Limited stocks in city; prompt del. from nearby plants by water
Lumber	Plenty; shipments heavy	Heavy shipments rec'd; no shortage	Mill deliveries easier	60,000,000 to 75,000,000 ft. in yards	Stocks increasing; demand decreasing	Dealers' stocks sufficient	Stocks low; demand slower	Plenty	Del. take 6 to 7 weeks from mill
Asphalt	Large native reserves	Demand steady; supply well maintained	About 10 cars	Plenty	Small reserve. Shipments as wanted		None in stock	50 to 100 cars	Heavy reserves N. J.
Structural steel	Bar stocks large; structurals fair, low on certain sizes	Mill deliveries take about two months	Warehouse stocks sufficient	Situation easier	Ample supply for immediate local needs	Difficulty in getting mill del. on bars	Enough; demand lessening with advance of season	6 to 8 cars on sidings	Mill shipments continue heavy

Production and Materials Stocks in Nine Cities

Steel and Lumber Demand Lessened—Output Slowing Down—Fewer Brick Available—Cement Scarce in Spots

Iron and Steel—The June pig-iron output averaged 122,280 gross tons per day as against 124,764 during the preceding month. This rate represents a falling off of nearly 2 per cent from the May average, which was the heaviest recorded in the history of the industry.

Steel mill operations are proceeding at about 85 per cent of capacity or slightly under the May production rate. Hot weather and labor shortage will probably cause further reduction in the July ingot output. Steel stocks have been restored to normal volume but with considerable falling off in new business, particularly in fabricated structurals.

Unfilled steel tonnage figures issued by the U. S. Steel Corporation, totaled 6,386,261 tons on June 30, against 6,981,351, May 31; 7,288,509, Apr. 30; 7,403,332, Mar. 31; 7,283,989, Feb. 28, and 6,910,776 on Jan. 31, 1923.

The following table shows steel ingot production in gross tons for the first half of the current year, compared with the corresponding period in 1922, as reported by the American Iron and Steel Institute:

	1923	1922
January	3,644,629	1,593,482
February	3,294,264	1,745,022
March	3,858,675	2,370,751
April	3,760,997	2,444,513
May	4,000,695	2,711,141
June	3,574,567	2,634,477
Total 6 months	22,133,827	13,499,386

Lumber—Production stands at about 4 per cent above normal or a trifle under the level prevailing one month ago. Shipments represents 104 per cent and orders, 79 per cent of normal production. One year ago production was 10 per cent below normal; shipments, 97 per cent and orders, 84 per cent of normal production. The present situation is one of slight reduction in output but a heavy falling off in both shipments and demand. The following table shows lumber movements during the four weeks ending June 30, compared with the preceding four weeks:

	Four Weeks Ending June 30 ft.b.m.	Four Weeks Ending June 2 ft.b.m.
Cut	1,054,593,013	1,102,856,280
Shipments	955,820,785	1,035,352,851
Orders	767,262,177	857,074,302

Cement—Stocks on hand throughout the entire country June 1, totaled 10,115,000 bbl., as against 12,893,000 for the corresponding period in 1922, according to the Geological Survey. Production amounted to 12,910,000 bbl. during May, compared with 11,176,000 for the same month last year. Shipments totaled 14,257,000 bbl., against 12,749,000 during May, 1922. Compared with a year ago, the cement situation is one of increased production, and still more greatly increased shipments, leaving reserve stocks at mills over 2,000,000 bbl. under the amount on hand June 1, 1922.

Brick—Burned brick on hand totaled 137,520,000 as of June 1, compared with 150,316,000 for the month preceding, according to the Common Brick Manufacturers' Association of America. Orders on books decreased 25 to 50 per cent, compared with the May 1 record, in all districts except two, located in the Middle West. No slackening in production is anticipated unless there occurs a much greater cut in new business than has yet appeared.

San Francisco—Fairly heavy stocks of triangle mesh, expanded metal lath, track supplies and lime. Stocks low on cement, rivets, blue annealed steel sheets and certain sizes of steel structurals. Large reserves of asphalt, road oils, sewer pipe and steel bars; plenty of railway ties, cut nails and common brick. Dealers' reserves of crushed stone, hollow tile, galvanized steel sheets and explosives in good shape; stocks of black steel sheets and wire nails, however, in poor condition.

Los Angeles—Enough sewer pipe but no large surplus. Increased scarcity of cement, due to heavy demand, causing anxiety among builders and contractors. Cement mills increasing output. No shortage of any other materials.

Denver — Between 4,000,000 and 5,000,000 burned brick on hand, against 500,000, one month ago. Lumber production exceeding demand.

Minneapolis—Situation easier in all materials. Dealers, generally, report stocks of brick, tile and cement in good condition. Lime not kept in large quantities in dealers' warehouses but shipped in from mills on short notice. Lumber stocks normal for season with 60,000,000 to 75,000,000 ft. in Twin City yards.

Detroit—Plenty of all materials except hollow tile and asphalt. Large deliveries of tile available on five to six days notice; small supplies in stock. Asphalt shipped from refineries as wanted; dealers' reserves small.

Cincinnati—Scarcity of cement; other materials plentiful. Difficulty experienced in obtaining mill deliveries on reinforcing bars.

New Orleans—Lumber demand somewhat lessened; stocks low. Abundance of other materials due to slowing up of demand as summer advances.

Atlanta—About seventy-five cars of lime; between fifty and one hundred cars of asphalt; from fifty to seventy-five cars of cement and from six to eight cars of steel structurals, now on sidings. Plenty of brick and lumber. Sewer pipe and hollow tile deliveries take four to five days from mill.

New York—Scarcity of brick continues. Brickyards are unable to keep abreast of demand, owing to fuel and transportation difficulties encountered last year and labor disturbances occuring during the current season. Building materials dealers maintain small local stocks because of limited space; quick mill deliveries by rail and water are depended upon to supply the market. Therefore, a shortage at the mill rather than at the warehouse would seriously affect the New York builder.

Decrease in Brick Orders

Current reports from brick manufacturers from all parts of the country, according to the monthly statement issued July 1 by the Common Brick Man-

ufacturers' Association of Cleveland, show that there is a general decrease in orders on books. Only two districts show gains over the previous month, and all others are from 25 to 50 per cent below the May record. In the Illinois, Indiana and Wisconsin district, influenced very largely by figures from Chicago, orders on books have been increased by 15,000,000 bricks since last month. Nebraska, Iowa, Kansas and Missouri also report an increase in orders. The latter states were among the last to show evidences of the building tide of the present year.

There has been no slackening in production, the manufacturers report, and there probably will be none until there is a greater cut in new business than has yet appeared. The price remains stable, Chicago continuing to be the minimum price market with brick at $12 per thousand delivered on the job. New York has the highest price, due, according to manufacturers, to heavy delivery and towing charges and dealers' profits. New York, it is pointed out, is the only large building center where the entire supply of common brick is handled through dealers.

Summer Dullness in Lumber

With production at 261,887,887 ft., shipments at 238,716,310 ft. and orders at 180,939,467 ft., there were further seasonal recessions in the nation's lumber movement in the week ended June 30, according to reports from 385 of the leading mills of the country as compared with 422 mills the week before, says the National Lumber Manufacturers' Association, but they were about what the customary seasonal curve would indicate. Production and shipments were above the 1922 rate.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of July 5; the next, on Aug. 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.30	—$4.30	$3.40	$3.55	$4.20	—$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	5.00	4.95	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.25	3.80	3.32½	3.45	3.85	—3.50	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.30	+58.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	+2.80	2.85	2.25	2.20	+2.50	2.84	—2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—63.00	42.00	—52.25	58.50	43.75	—48@53	41.00	31.00	—70.00
Lime, finishing, hydrated, ton	18.20	23.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	+ 2.10	2.80	10.00
Common brick, delivered, 1,000	+23.50@24.60	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	—.0724	—.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	1.13	1.20	—1.32	—1.28	—1.24	—1.34	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.55	.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5¼ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.20). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Slight weakening in steel warehouse quotations is beginning to appear, consequent to recent concessions in mill prices, due to lower costs of iron and a lessening in demand for steel. Dallas reports a reduction of 20c. and San Francisco, 35c. per 100 lb. on structural shapes. Plates and shapes are holding steadily at $2.50 per 100 lb. at Pittsburgh mill on the majority of orders. Base price of bars still $2.40. Demand has been more active in plates and structurals in the last two weeks than during the two weeks preceding. Tank construction is taking the bulk of the plate business, with railroad requirements next in order of heavy buying.

The June pig-iron output was nearly as heavy as the month preceding, despite hot weather. The third-quarter buying movement, however, is not developing according to expectations and there is a tendency to shade pig-iron prices to points but slightly above the cost of production.

Lumber prices show downward tendencies in several important centers, consequent to a falling off in demand. New York quotes a reduction of $1 and Dallas, $2.75 per M. ft. on yellow pine timbers, while still heavier reductions occurred in Denver and Montreal on Douglas fir.

Linseed oil dropped 1c. in Chicago; 3c. in Dallas and 5c. per gal. in Minneapolis and Denver, during the week.

Common brick is quoted at $20@$21 per M. wholesale, alongside dock, New York, as against $20 since the first of the year. Cement is also firmer at $2.80 per bbl. delivered, without bags. Pine lumber, however, declined $1 per M. ft. on structural timbers.

Cement advanced 11c. per bbl., July 9, in Duluth, Minneapolis and St. Paul.